



Service Manual

Sand Pro[®] 2020/3020/5020

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repair of major systems and components on the Sand Pro 2020/3020/5020.

REFER TO THE OPERATOR'S MANUALS FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manuals and Parts Catalogs for your machine. Replacement Operator's Manuals are available by sending complete Model and Serial Number to:

The Toro Company
8111 Lyndale Avenue South
Bloomington, MN 55420-1196

The Toro Company reserves the right to change product specifications or this publication without notice.



NOTE: A NOTE will give general information about the correct operation, maintenance, service, testing, or repair of the machine.

IMPORTANT: The IMPORTANT notice will give important instructions which must be followed to prevent damage to systems or components on the machine.



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Briggs & Stratton Vanguard Service and Repair Manual
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Safety

Product Records
and Manuals

Engine

Hydraulic
Systems

Electrical
Systems

Wheels, Brakes
and Miscellaneous

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General Safety Instructions

The Sand Pro 2020/3020 were tested and certified by TORO for compliance with the B71.4–1984 specifications of the American National Standards Institute. Although hazard control and accident prevention partially are dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern, and proper training of the personnel involved in the operation, transport, maintenance, and storage of the machine. Improper use or maintenance of the machine can result in injury or death.

Before Operating

1. Operate machine only after reading and understanding the contents of this manual. A replacement manual is available by sending complete model and serial number to:

The Toro Company
8111 Lyndale Avenue South
Minneapolis, Minnesota 55420–1196
2. Never allow children to operate the machine or adults to operate it without proper instructions.
3. Become familiar with the controls and know how to stop the engine quickly.
4. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is malfunctioning, illegible, or damaged, repair or replace it before operating the machine.
5. Always wear substantial shoes. Do not operate machine while wearing sandals, tennis shoes or sneakers. Do not wear loose fitting clothing which could get caught in moving parts and cause personal injury.
6. Wearing safety glasses, safety shoes, long pants and a helmet is advisable and required by some local safety and insurance regulations.
7. Ensure traction interlock switch is adjusted correctly so engine cannot be started unless traction pedal is released and in neutral position.
8. Keep everyone, especially children and pets away from the areas of operation.
9. Gasoline is highly flammable; handle it carefully.
 - A. Use an approved gasoline container.
 - B. Do not remove cap from fuel tank when engine is hot or running.
 - C. Do not smoke while handling gasoline.
 - D. Fill fuel tank outdoors to about one inch below top of tank, (bottom of filler neck). Do not overfill.
 - E. Wipe up any spilled gasoline.
10. Check the safety interlock system daily for proper operation (see Check Interlock System in Chapter 5 – Electrical Systems). If the switch should malfunction, replace switch before operating machine. (After every two years, replace interlock switch in the safety system, whether it is working properly or not.)



WARNING

To reduce the potential for injury or death, comply with the following safety instructions.

While Operating

11. Exhaust fumes are hazardous and could be deadly, so do not run the engine in a confined area without adequate ventilation.
12. Sit on seat when operating the machine. Never carry passengers.
13. When starting the engine:
 - A. Make sure traction pedal is released.
 - B. After the engine is started, keep foot off traction pedal. Machine must not move. If movement is evident, the neutral return mechanism is adjusted incorrectly; therefore, shut engine off and readjust mechanism so machine does not move when in neutral position. If engine does not start, check interlock switch connections.
14. Using the machine demands attention. To prevent tipping or loss of control:
 - A. Use care when entering and leaving sand traps. Use extreme caution around ditches, creeks or other hazards.
 - B. Watch for holes or other hidden hazards.
 - C. Use caution when operating machine on a steep slope. Reduce speed when making sharp turns or when turning on hillsides.
 - D. Avoid sudden stops and starts. Do not go from reverse to full forward without first coming to a complete stop.
 - E. Before backing up, look to the rear and assure no one is behind the machine.
 - F. Watch out for traffic when near of crossing roads. Always yield the right of way.
15. If optional Draw Bar (Part No. 92-2330) or Hitch Kit (Model No. 08833) is installed on machine, vertical load on hitch should not exceed 200 lbs.
16. Do not touch engine, muffler or exhaust pipe while engine is running or soon after it has stopped because these areas are hot enough to cause burns.
17. If the machine ever vibrates abnormally, stop immediately, turn engine off, wait for all motion to stop and inspect for damage. Repair all damage before commencing operation.
18. Before getting off the seat:
 - A. Stop movement of the machine.
 - B. Set parking brake and lower attachments to the ground. Take precautions to prevent accidental starts, rolling away, etc.
19. Whenever machine is left unattended, be sure engine is stopped, parking brake is set, attachments are lowered to the ground, and key is removed from ignition.

Maintenance and Service

20. Before servicing or making adjustments to the machine, stop engine, remove key from the ignition, and pull the spark plug wire off spark plug to prevent accidental starting of the engine.
21. Make sure all hydraulic line connectors are tight, and all hydraulic hoses and lines are in good condition before applying pressure to the system.
22. Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate skin and do serious damage. If fluid is injected into the skin it must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.
23. Before disconnecting or performing any work on the hydraulic system, all pressure in system must be relieved by stopping engine, engaging parking brake and lowering attachments to the ground.
24. To make sure entire machine is in good condition, keep all nuts, bolts and screws properly tightened.
25. If major repairs are ever needed or assistance is required, contact an Authorized TORO Distributor.
26. To reduce potential fire hazard, keep the engine area free of excessive grease, grass, leaves and accumulation of dirt.
27. If the engine must be running to perform a maintenance adjustment, keep hands, feet, clothing, and any parts of the body away from the engine and any moving parts. Keep everyone away.
28. Do not overspeed engine by changing governor settings. Maximum engine speed is 3200 rpm. To assure safety and accuracy, have an Authorized Toro Distributor check maximum engine speed with a tachometer.
29. Engine must be shut off before checking oil or adding oil to the crankcase.
30. To be sure of optimum performance and safety, always purchase genuine TORO replacement parts and accessories. Replacement parts and accessories made by other manufacturers could be dangerous. Such use could void the product warranty of The Toro Company.
31. When changing attachments, tires, or performing other service, use correct blocks, hoists, and jacks. Make sure machine is parked on a solid level floor such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Used jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or jack stands, the machine may move or fall, which may result in personal injury.

Jacking Instructions



CAUTION

When changing attachments, tires, or performing other service, use correct blocks, hoists, and jacks. Make sure machine is parked on a solid level floor such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Used jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or jack stands, the machine may move or fall, which may result in personal injury.

Use the following positions when jacking up the machine:

Jacking the Front End

1. On the **SP 2020/3020**, jack from below the front cross support that is above the retaining strip for the rubber shield (Fig. 1).
2. On the **SP 5020**, jack from below the front cross support tube on the bottom of the frame (Fig. 2).

Jacking the Rear End

1. On the **SP 2020/3020**, jack from below the square tube of the frame (Fig. 3).
2. On the **SP 5020**, jack from below the square tube of the frame (Fig. 3).



Figure 1



Figure 2

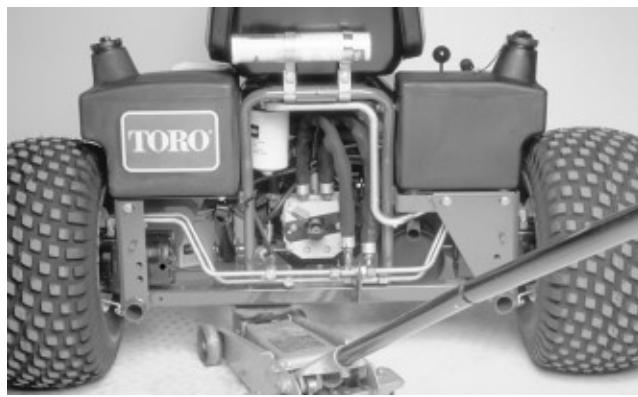


Figure 3

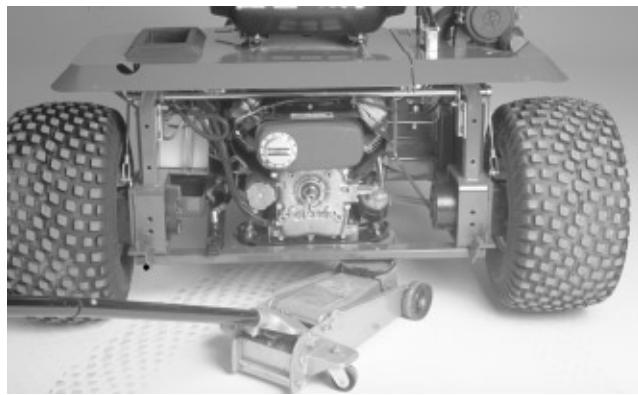


Figure 4



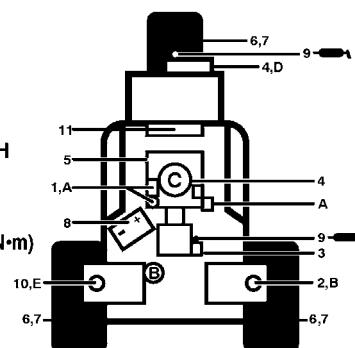
Safety and Instruction Decals

The following safety and instruction decals are installed on the Sand Pro 2020/3020. If any become damaged or illegible, replace them. Decal part numbers are listed below and in the parts catalog. Order replacements from your Authorized Toro Distributor.

SAND PRO 2020 & 3020 QUICK REFERENCE AID

CHECK/SERVICE (DAILY)

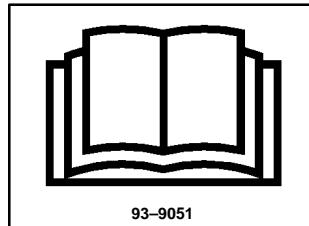
1. OIL LEVEL, ENGINE
2. OIL LEVEL, HYDRAULIC TANK
3. TRACTION NEUTRAL INTERLOCK SWITCH
4. AIR CLEANERS
5. ENGINE COOLING FINS
6. TIRE PRESSURE (4-6 psi/.3-.4 bar)
7. WHEEL NUT TORQUE (45-55 Ft-Lbs/ 61-75 N·m)
8. BATTERY
9. LUBRICATION
10. FUEL GAS ONLY
11. HYDRAULIC OIL COOLING FINS



FLUID SPECIFICATION/CHANGE INTERVALS

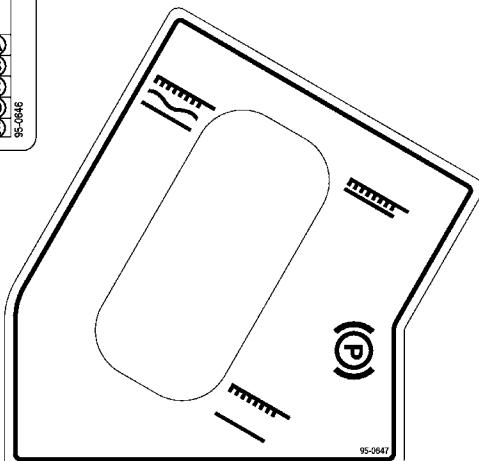
SEE OPERATOR'S MANUAL FOR INITIAL CHANGE	FLUID TYPE	CAPACITY	CHANGE INTERVALS	FILTER PART NO.
A. ENGINE OIL	SAE 30 SG	*1.75 QTS.	25 HRS. 100 HRS.	**492932 (A)
B. HYDRAULIC OIL	MOBIL 424	* 3 GAL.	400 HRS. 400 HRS.	23-9740 (B)
C. AIR CLEANER (ON ENGINE)			**400 HRS.	**394018 (C)
D. AIR CLEANER (ON HOOD)			**400 HRS.	93-2195 (D)
E. FUEL TANK/FILTER	UNLEADED GAS	4.25 GAL.	*800 HRS.	94-2690 (E)

*INCLUDING FILTER **CLEAN EVERY 100 HRS ^ OR YEARLY WHICHEVER IS LESS ** BRIGGS AND STRATTON PART NUMBER.

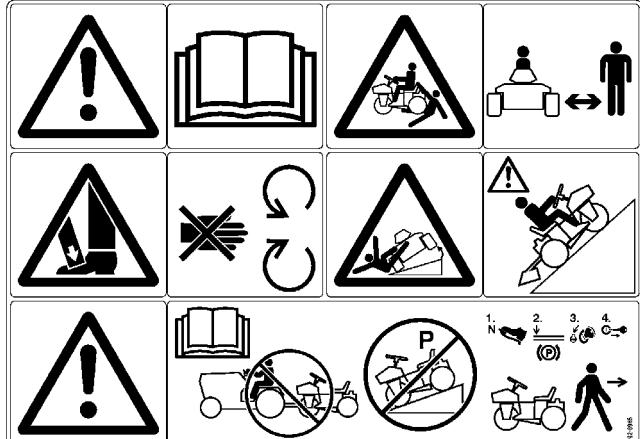


93-9051

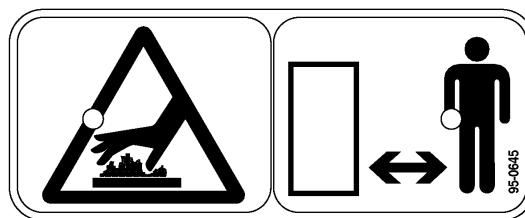
ON NEUTRAL ADJUST MECHANISM
(Part No. 93-9051)



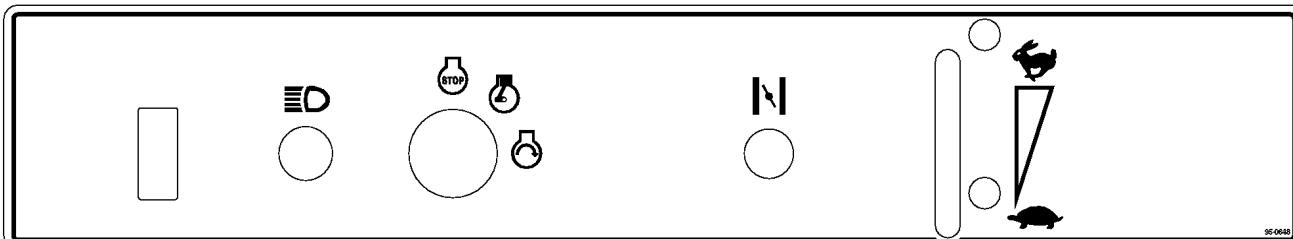
ON VALVE SHROUD
(Part No. 95-0647)



ON ENGINE SHIELD
(Part No. 92-8985)



ON ENGINE SHIELD
(Part No. 95-0645)

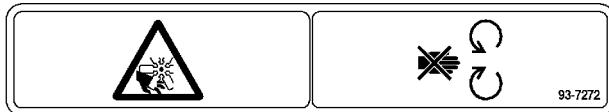


ON DASH PANEL
(Part No. 95-0648)

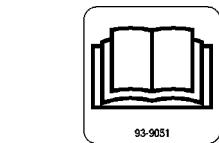
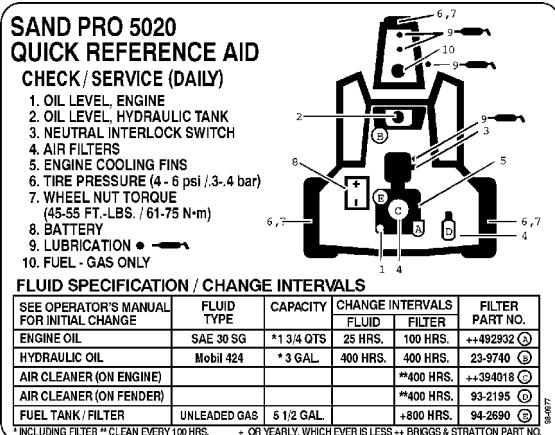


Safety and Instruction Decals

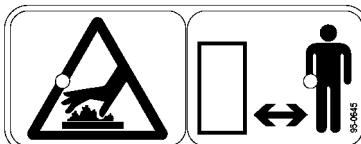
The following safety and instruction decals are installed on the Sand Pro 5020. If any become damaged or illegible, replace them. Decal part numbers are listed below and in the parts catalog. Order replacements from your Authorized Toro Distributor.



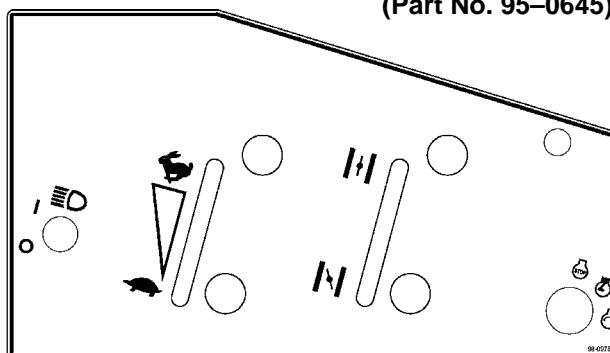
ON BOTH SIDES OF FAN SHROUD (2)
(Part No. 93-7272)



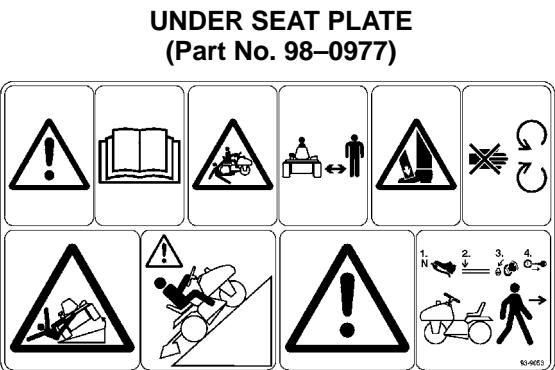
**ON NEUTRAL ADJUST
MECHANISM**
(Part No. 93-9051)



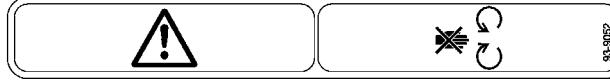
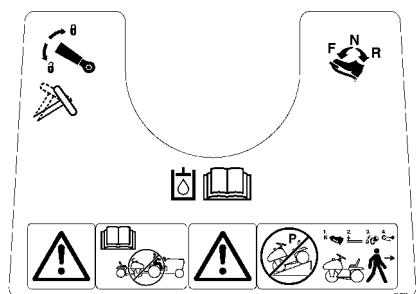
ON MUFFLER SHIELD
(Part No. 95-0645)



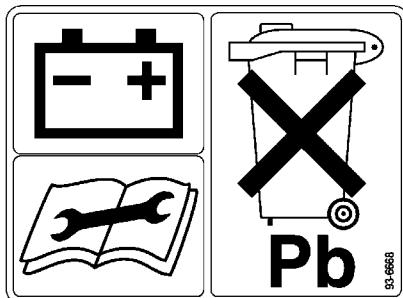
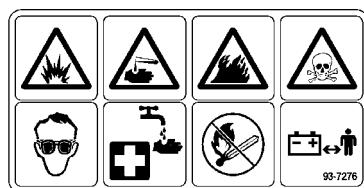
ON RIGHT FENDER
(Part No. 98-0975)



ON LEFT FENDER
(Part No. 93-9053)



**ON FRAME & BOTH SIDES
OF CENTER PANEL (3)**
(Part No. 93-9052)





Chapter 2

Product Records and Maintenance

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Product Records

Record maintenance and repair information about your Sand Pro 2020/3020/5020 on the OPERATION AND SERVICE HISTORY REPORT form. Use this information when referring to your machine.

Insert Operator's Manuals and Parts Catalogs for your Sand Pro 2020/3020/5020 at the end of this section.

Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm
1/64	0.015625	— 0.397	33/64	0.515625	— 13.097
1/32	0.03125	— 0.794	17/32	0.53125	— 13.494
3/64	0.046875	— 1.191	35/64	0.546875	— 13.891
1/16	0.0625	— 1.588	9/16	0.5625	— 14.288
5/64	0.078125	— 1.984	37/64	0.578125	— 14.684
3/32	0.09375	— 2.381	19/32	0.59375	— 15.081
7/64	0.109275	— 2.778	39/64	0.609375	— 15.478
1/8	0.1250	— 3.175	5/8	0.6250	— 15.875
9/64	0.140625	— 3.572	41/64	0.640625	— 16.272
5/32	0.15625	— 3.969	21/32	0.65625	— 16.669
11/64	0.171875	— 4.366	43/64	0.671875	— 17.066
3/16	0.1875	— 4.762	11/16	0.6875	— 17.462
13/64	0.203125	— 5.159	45/64	0.703125	— 17.859
7/32	0.21875	— 5.556	23/32	0.71875	— 18.256
15/64	0.234375	— 5.953	47/64	0.734375	— 18.653
1/4	0.2500	— 6.350	3/4	0.7500	— 19.050
17/64	0.265625	— 6.747	49/64	0.765625	— 19.447
9/32	0.28125	— 7.144	25/32	0.78125	— 19.844
19/64	0.296875	— 7.541	51/64	0.796875	— 20.241
5/16	0.3125	— 7.938	13/16	0.8125	— 20.638
21/64	0.328125	— 8.334	53/64	0.828125	— 21.034
11/32	0.34375	— 8.731	27/32	0.84375	— 21.431
23/64	0.359375	— 9.128	55/64	0.859375	— 21.828
3/8	0.3750	— 9.525	7/8	0.8750	— 22.225
25/64	0.390625	— 9.922	57/64	0.890625	— 22.622
13/32	0.40625	— 10.319	29/32	0.90625	— 23.019
27/64	0.421875	— 10.716	59/64	0.921875	— 23.416
7/16	0.4375	— 11.112	15/16	0.9375	— 23.812
29/64	0.453125	— 11.509	61/64	0.953125	— 24.209
15/32	0.46875	— 11.906	31/32	0.96875	— 24.606
31/64	0.484375	— 12.303	63/64	0.984375	— 25.003
1/2	0.5000	— 12.700	1	1.000	— 25.400
1 mm = 0.03937 in.			0.001 in. = 0.0254 mm		

U.S to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
Pressure	Pounds/Sq. In.	Kilopascal	6.895
	Pounds/Sq. In.	Bar	0.069
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1383
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subtract 32° 2. Multiply by 5/9

Torque Specifications

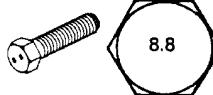
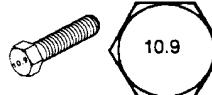
Use these torque values when specific torque values are not given. DO NOT use these values in place of

specified values. Torque values listed are for lubricated threads. Plated threads are considered to be lubricated.

Capscrew Markings and Torque Values - U.S. Customary

SAE Grade Number	5				8			
Capscrew Head Markings								
Capscrew Body Size	Capscrew Torque - Grade 5		Capscrew Torque - Grade 8		Capscrew Torque - Grade 5		Capscrew Torque - Grade 8	
	ft-lb	Cast Iron Nm	ft-lb	Aluminum Nm	ft-lb	Cast Iron Nm	ft-lb	Aluminum Nm
1/4-20 -28	7 9	9 12	6 7	8 9	11 13	15 18	9 10	12 14
5/16-18 -24	15 17	20 23	12 14	16 19	22 24	30 33	18 19	24 25
3/8-16 -24	30 30	40 40	20 25	25 35	40 45	55 60	30 35	40 45
7/16-14 -20	45 50	60 65	35 40	45 55	65 70	90 95	50 55	65 75
1/2-13 -20	70 75	95 100	55 60	75 80	95 110	130 150	75 90	100 120
9/16-12 -18	100 110	135 150	80 85	110 115	140 155	190 210	110 125	150 170
5/8-11 -18	135 155	180 210	110 120	150 160	190 215	255 290	150 170	205 230
3/4-10 -16	240 270	325 365	190 210	255 285	340 380	460 515	270 300	365 410
7/8-9 -14	360 390	490 530	280 310	380 420	550 610	745 825	440 490	600 660
1-8 -14	530 590	720 800	420 480	570 650	820 890	1100 1200	660 710	890 960

Capscrew Markings and Torque Values – Metric

Commercial Steel Class	8.8				10.9				12.9			
Capscrew Head Markings												
Thread Diameter mm	Capscrew Torque - Class 8.8				Capscrew Torque - Class 10.9				Capscrew Torque - Class 12.9			
	ft-lb	Cast Iron Nm	ft-lb	Aluminum Nm	ft-lb	Cast Iron Nm	ft-lb	Aluminum Nm	ft-lb	Cast Iron Nm	ft-lb	Aluminum Nm
6	5	9	4	7	9	14	7	11	9	14	7	11
7	9	14	7	11	14	18	11	14	18	23	14	18
8	18	25	14	18	23	32	18	25	27	36	21	28
10	30	40	25	30	45	60	35	45	50	70	40	55
12	55	70	40	55	75	105	60	80	95	125	75	100
14	85	115	65	90	120	160	95	125	145	195	110	150
16	130	180	100	140	175	240	135	190	210	290	165	220
18	170	230	135	180	240	320	185	250	290	400	230	310

Lubrication



CAUTION

Before servicing or making adjustments to the machine, stop engine, set parking brake, and remove key from the ignition switch.

Lubricate grease fittings regularly with No. 2 general purpose lithium base grease. Lubricate front wheel bearing and traction control linkage every 25 hours of operation. Lubricate steering shaft and steering shaft sprocket every 100 hours.

Sand Pro 2020/3020 (Early Models)

The **three** fittings that must be lubricated are: front wheel bearing (Fig. 1), traction control linkage (Fig. 3) and steering shaft (Fig. 4).

Sand Pro 2020/3020 (Late Models)

The **four** fittings to lubricate are: front wheel bearing (Fig. 1), traction control linkage (Fig. 3) and steering shaft and steering chain sprocket shaft(Fig. 5).

Sand Pro 5020

The **four** fittings to lubricate are: front wheel bearing (Fig. 2), traction control linkage (Fig. 3), and both the steering shaft and steering chain sprocket shaft (Fig. 6).

NOTE: On the **Sand Pro 5020**, gain access to the grease fitting on the traction control linkage (Fig. 3) by removing the right side panel.

1. Wipe grease fitting clean so foreign matter cannot be forced into the bearing or bushing.
2. Pump grease into the bearing or bushing. Wipe up excess grease.

NOTE: Do not lubricate steering chain unless it becomes stiff from rust. If the chain rusts, it may be lubricated lightly with a **dry type lubricant**.

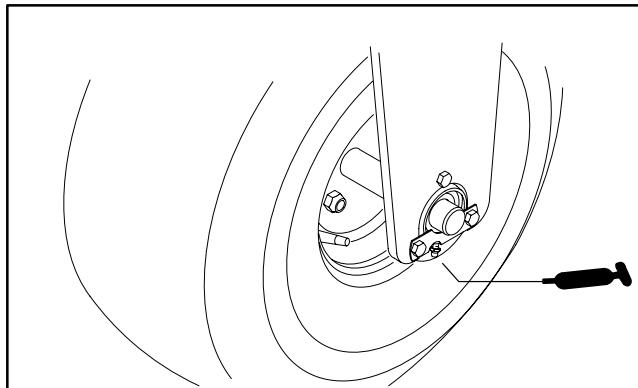


Figure 1

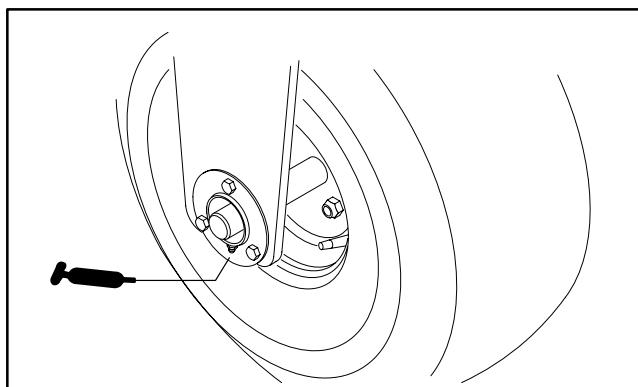


Figure 2

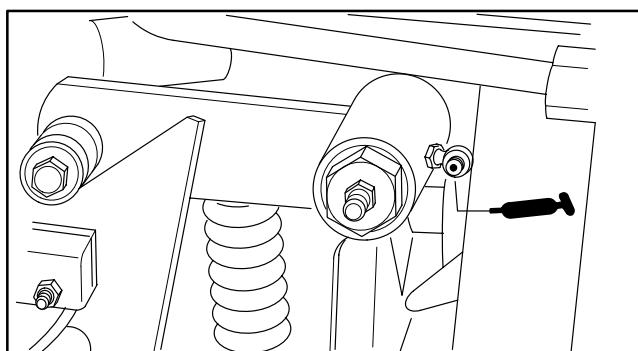


Figure 3

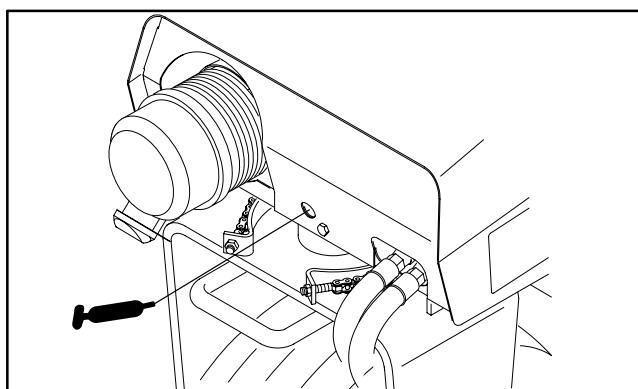


Figure 4

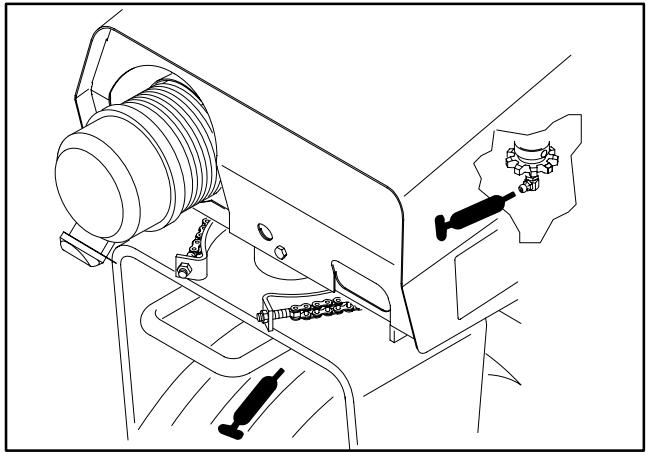


Figure 5

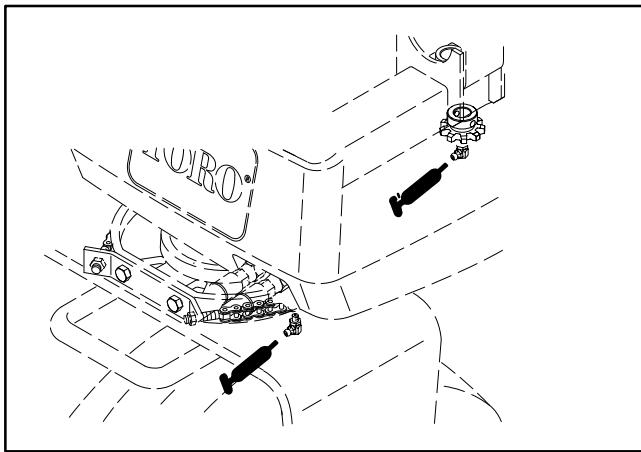


Figure 6



EQUIPMENT OPERATION AND SERVICE HISTORY REPORT
for
Sand Pro® 2020/3020/5020

TORO Model and Serial Number: _____ - _____

Engine Numbers: _____

Transmission Numbers: _____

Date Purchased: _____

Warranty Expires _____

Purchased From:

Contacts:	Parts	Phone _____
	Service	Phone _____
	Sales	Phone _____

See your TORO Distributor for other Publications, Manuals, and Videos from the TORO company.

Minimum Recommended Maintenance Intervals:

Maintenance Procedure	Maintenance Interval & Service		
Check Battery Fluid Level	Every 25hrs	Every 100hrs	Every 400hrs
Check Battery Cable Connections			Every 800hrs
† Change Engine Oil			
Lubricate Front Wheel Bearing	<i>A-Level Service</i>		
Lubricate Traction Control Linkage			
Replace Engine Oil Filter			
Inspect Remote Air Cleaner Element			
Inspect Engine Air Cleaner Element			
Lubricate Steering Shaft Grease Fitting			
Check Steering Chain Adjustment		<i>B-Level Service</i>	
† Torque Wheel Lug Nuts			
Change Hydraulic Oil			
† Replace Hydraulic Oil Filter			
Replace Remote Air Cleaner Element		<i>C-Level Service</i>	
Replace Engine Air Cleaner Element			
Replace Spark Plugs			
Replace Fuel Filter			
Decarbonize Combustion Chamber			
Adjust Valves and Torque Head Bolts			
Check Engine RPM (idle and full throttle)			<i>D-Level Service</i>
Drain and Clean Fuel Tank			
† Initial break in at 8 hours			
Replace Moving Hoses	Annual Recommendations: <i>Items listed are recommended every 1,500 hours or 2 years, whichever comes first.</i>		
Replace Traction Interlock (Safety) Switch			
(See proper section of Operator's and Service Manuals for procedures and fluid specifications.)			

Sand Pro ® 2020/3020/5020 Daily Maintenance Checklist

Daily Maintenance: (duplicate this page for routine use)

Maintenance Check Item ▾	Daily Maintenance Check For Week Of _____						
	MON	TUES	WED	THURS	FRI	SAT	SUN
✓ Safety Interlock Operation							
✓ Steering Operation							
✓ Engine Oil Level							
✓ Remote/Engine Air Cleaner Condition							
Clean Engine Cooling Fins							
✓ Unusual Engine Noises							
✓ Unusual Operating Noises							
✓ Hydraulic System Oil Level							
✓ Hydraulic Hoses for Damage							
✓ Fluid Leaks							
✓ Fuel Level							
✓ Tire Pressure							
✓ Instrument Operation							
Touch-up Damaged Paint							

Notation for areas of concern:

Inspection performed by: _____

Item	Date	Information
1		
2		
3		
4		
5		
6		
7		
8		

(Check proper section of Operator's and Service Manuals for procedures and fluid specifications.)

Sand Pro ® 2020/3020/5020 Maintenance Supervisor Work Order

Date: _____

(Duplicate this page for routine use.)

Unit Designation:	TORO I.D. #:
Hours:	Service to perform (circle):
A B C D Other	
Technician:	

Remarks:

A – Service (every 25 hours)

- Check Battery Fluid Level
 - Check Battery Cable Connections
 - Change Engine Oil
 - Lubricate Front Wheel Bearing
 - Lubricate Traction Control Linkage
 - _____
 - _____
 - _____
- A – Service required**

B – Service (every 100 hours)

- Replace Engine Oil Filter
 - Inspect Remote Air Cleaner Element
 - Inspect Engine Air Cleaner Element
 - Lubricate Steering Shaft Grease Fitting
 - Check Steering Chain Adjustment
 - Torque Wheel Lug Nuts
 - _____
 - _____
 - _____
- A – Service required**

C – Service (every 400 hours)

- Change Hydraulic Oil
- Replace Hydraulic Oil Filter
- Replace Remote Air Cleaner Element
- Replace Engine Air Cleaner Element
- A and B – Service required**
- _____
- _____
- _____

Other – Annual Service and Specials

- Replace Moving Hoses
- Replace Traction Interlock (Safety) Switch
- A, B, C, and D – Service Required**
- _____
- _____
- _____
- _____
- _____

D – Service (every 800 hours)

- Replace Spark Plugs
- Replace Fuel Filter
- Decarbonize Combustion Chamber
- Adjust Valves and Torque Head Bolts
- Check Engine RPM (idle and full throttle)
- Drain and Clean Fuel Tank
- A, B, and C – Service required**
- _____
- _____



Chapter 3

Engine

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Engine

Introduction

This Chapter gives information about specifications, maintenance, troubleshooting, testing, and repair of the gasoline engines used in the Sand Pro 2020, 3020, and 5020.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Briggs and Stratton Vanguard Repair and Service Manual for 4-Cycle V-Twin Cylinder OHV Engines. The use of some specialized test

equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Briggs and Stratton Vanguard engines are supplied through your local Briggs and Stratton dealer or distributor. If no parts list is available, be sure to provide your distributor with the Toro model and serial number.

Specifications

Item	Description
Make / Designation	Briggs and Stratton Vanguard, 4-Cycle, V-Twin Cylinder, OHV, Air Cooled, Gasoline Engine
Horse Power SP 2020/3020 SP 5020	16 HP @ 3600 RPM 18 HP @ 3600 RPM
Bore mm (in.) SP 2020/3020 SP 5020	68.0 (2.677) 71.98 (2.834)
Total Displacement cc (cu. in.) SP 2020/3020 SP 5020	480 (29.3) 570 (34.8)
Fuel	Unleaded Regular Grade Gasoline
Fuel Capacity liters (gallons) SP 2020/3020 SP 5020	16.1 (4.25) 20.8 (5.50)
Fuel Pump	Pulsating Crankcase Vacuum
Governor	Mechanical
Low Idle (no load)	1750 ± 50 RPM
High Idle (no load)	3150 ± 50 RPM
Intake and Exhaust Valve Seat Angle	45°
Intake and Exhaust Valve Clearance (Cold) mm (in.)	0.10 to 0.15 (0.004 to 0.006)
Carburetor	Single Barrel, Float Feed with Suppress Afterfire Solenoid
Engine Oil	SAE 30 SE, SF, or SG
Oil Pump	Internal Gear Driven Gerotor Type
Crankcase Oil Capacity liters (U.S. qt.)	1.66 (1.75) with filter
Starter	12 VDC
Alternator/Regulator	12 VDC 16 AMP
Spark Plug	Champion RC12YC or NGK BKR4E or Equivalent
Spark Plug Gap mm (in.)	0.76 (0.030)

Engine

General Information

Check Engine Oil



CAUTION

Before servicing or making adjustments to the machine, make sure of the following: stop engine, engage parking brake, lower attachment, and remove key from the switch.

IMPORTANT: Check oil level every 8 operating hours or daily. Change oil initially after the first 8 hours of operation. Thereafter, change oil every 25 hours and filter every 100 hours under normal conditions. Change oil more frequently when the engine is operated in extremely dusty or dirty conditions.

The engine is shipped with 1–3/4 quarts (w/ filter) of oil in the crankcase; however, oil level must be checked before and after the engine is first started.

1. Position machine on a level surface.
2. Unscrew dipstick and wipe it with a clean rag. Screw dipstick into the tube, and make sure it is seated fully. Unscrew dipstick out of the tube. Check oil level. If oil level is low, remove filler cap from the valve cover (next to dipstick), and add enough oil to raise the level to the FULL mark on the dipstick.

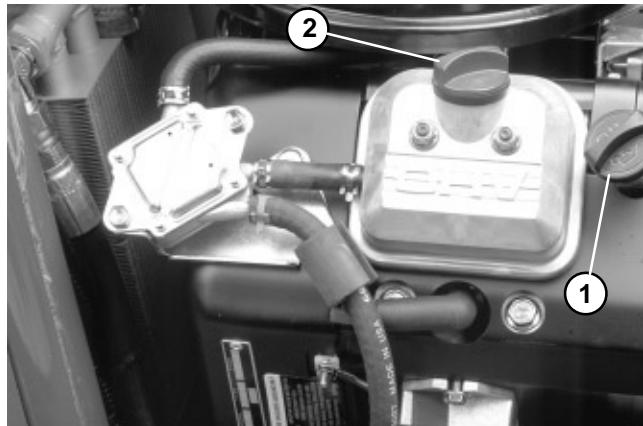


Figure 1

1. Dipstick
2. Filler cap

3. The engine uses any high-quality detergent oil having the American Petroleum Institute -API- "service classification" SE, SF or SG. Recommended viscosity (weight) is SAE 30.

IMPORTANT: Dipstick must be fully seated in tube to provide proper sealing of engine crankcase. Failure to seal crankcase may result in engine damage.

4. Install dipstick firmly into the tube.

Fuel Shutoff Valve

This valve should be shut when removing the engine or placing the unit in long term storage.

On the **SP 2020/3020**, the shutoff valve can be accessed from the rear of the machine (Fig. 2).

On the **SP 5020**, the shutoff valve can be accessed by removing the left side panel (Fig. 3).

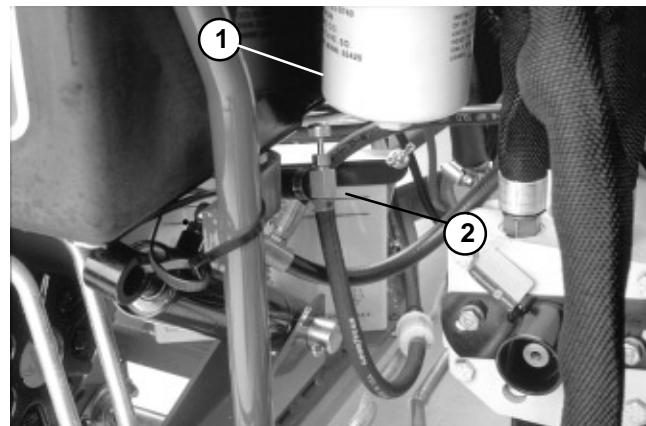


Figure 2

1. Fuel shutoff valve

2. Hydraulic oil filter

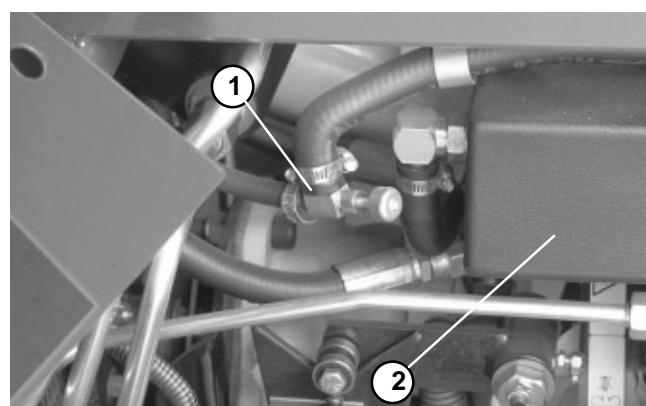


Figure 3

1. Fuel shutoff valve

2. Hydraulic oil tank

Fill Fuel Tank

IMPORTANT: The Toro Company strongly recommends using fresh, clean, unleaded regular grade gasoline in Toro gasoline powered products. Unleaded gasoline burns cleaner, extends engine life, and promotes good starting by reducing the build-up of combustion chamber deposits. Leaded gasoline can be used if unleaded is not available.

IMPORTANT: Never use methanol, gasoline containing methanol, gasoline containing more than 10% ethanol, gasoline additives, premium gasoline, or white gas. Damage may result to engine fuel system.

NOTE: Fuel tank capacity is about 4.25 gallons for the SP 2020/3020 and 5.5 gallons for the SP 5020.

1. Clean area around fuel tank cap.
2. Remove fuel tank cap.
3. Fill tank about one inch below top of the tank, (bottom of filler neck). **DO NOT OVERFILL.** Then install cap.
4. Prevent a fire hazard. Wipe up any spilled fuel.



DANGER

Gasoline is flammable; use caution when storing or handling it. Do not fill fuel tank while the engine is running, hot, or when machine is in an enclosed area. Vapors may build up, and can be ignited by a spark or flame source many feet away. Prevent the possibility of an explosion. DO NOT SMOKE while filling the fuel tank. Always fill fuel tank outside. Wipe up any spilled gasoline before starting the engine. Use a funnel or spout to prevent spilling gasoline. Fill tank no higher than one inch below top of tank, (bottom of filler neck). **DO NOT OVER FILL.** Store gasoline in a clean safety approved container and keep the cap on the container. Keep gasoline in a cool, well-ventilated place; never store in an enclosed area such as a hot storage shed. To assure volatility, do not buy more than a 30 day supply of gasoline. Gasoline is a fuel for internal combustion engines; do not use it for any other purpose. Many children like the smell of gas, so keep it out of their reach. Gas fumes are explosive and dangerous to inhale.

Adjustments

Adjust Throttle Control

Proper throttle operation is dependent upon the proper adjustment of the throttle control. Before adjusting the carburetor, assure throttle control is operating properly.

1. Pivot seat up. On the **SP 2020/3020**, remove the engine shield.
2. Loosen cable clamp screw securing the cable to the engine.
3. Move remote throttle control lever forward to the FAST position.
4. Pull firmly on the throttle cable until the back of throttle swivel contacts the throttle stop.
5. Tighten cable clamp screw. Check engine idle setting.
 - A. High Idle: 3150 ± 50
 - B. Low Idle: 1750 ± 50

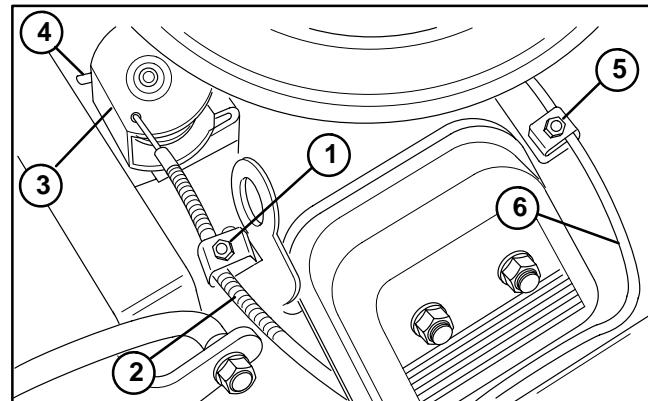


Figure 4

- | | |
|----------------------|----------------------|
| 1. Cable clamp screw | 4. Throttle stop |
| 2. Throttle cable | 5. Cable clamp screw |
| 3. Throttle swivel | 6. Choke cable |

Adjust Choke Control

1. Pivot seat up. On the **SP 2020/3020**, remove the engine shield.
2. Remove air cleaner cover, cover plate, and air cleaner filter element from the air cleaner base (See Service Engine Air Cleaner).
3. Loosen cable clamp screw securing the choke cable to engine (Fig. 4).
4. Pull choke control knob out completely from dash panel (**SP 2020/3020**). Shift choke lever to the choke position (**SP 5020**).

NOTE: Newer engine models will have a different carburetor shield that has five hex head flange screws securing the shield and air cleaner base to the carburetor.

5. Pull firmly on the choke cable until the choke butterfly is completely closed. Make sure choke control knob is still pulled out completely or the choke lever is shifted to choke, then tighten cable clamp screw (Fig. 4).
6. Reinstall air cleaner filter element, cover plate, and air cleaner cover to the air cleaner base (See Service Engine Air Cleaner).

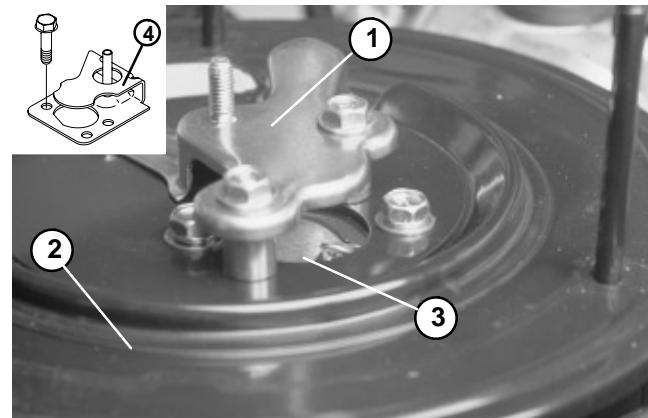


Figure 5

- | | |
|----------------------|-------------------------------------|
| 1. Carburetor shield | 4. Carburetor shield (newer models) |
| 2. Air cleaner base | |
| 3. Choke butterfly | |

Service and Repairs

Change Engine Oil and Filter

Change oil initially after the first 8 hours of operation. Thereafter, change oil every 25 hours and filter every 100 hours.

1. Park machine on a level surface. Turn engine off.
2. Pivot seat up. On the **SP 2020/3020**, remove the engine shield.
3. Remove drain plug and let oil flow into drain pan. When oil stops, install drain plug.
4. Remove oil filter. Apply a light coat of clean oil to the new filter gasket.
5. Screw filter on by hand until gasket contacts filter adapter, then tighten 1/2 to 3/4 turn further. DO NOT OVER-TIGHTEN.
6. Add oil to crankcase (see Check Engine Oil). Dispose of oil properly.

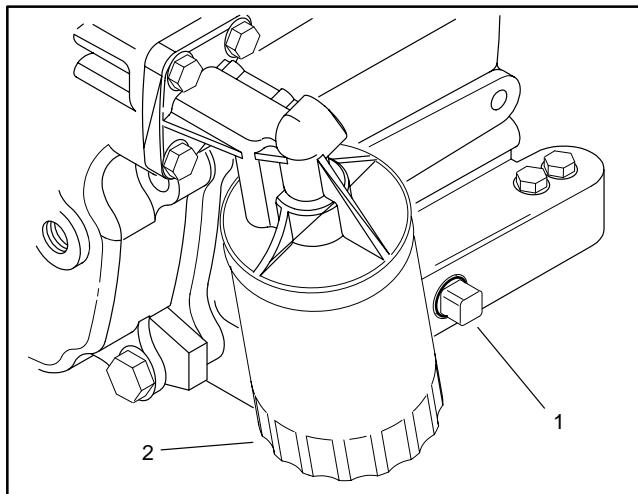


Figure 6

1. Drain plug

2. Oil filter

Service Engine Air Cleaner

Inspect paper element every 100 hours of operation. Replace element every 400 hours or when dirty or damaged. Do not wash paper element or do not clean with compressed air as damage will occur.

1. Park machine on a level surface. Turn engine off.
2. Pivot seat up. On the **SP 2020/3020**, remove the engine shield.
3. Remove knobs and air cleaner cover.
4. Remove filter element and cover plate. Inspect filter for cleanliness, ruptures, holes, and tears. Replace defective filter element.
5. With air cleaner disassembled, check air cleaner components for damage. Replace if necessary.
 - A. Make sure rubber breather tube in base plate is securely in place or **severe** engine damage may occur.
 - B. Make sure carburetor breather hose is routed out through engine vents.
6. Reinstall filter element. Secure element with cover plate and knob. Reinstall air cleaner cover and secure with knobs.

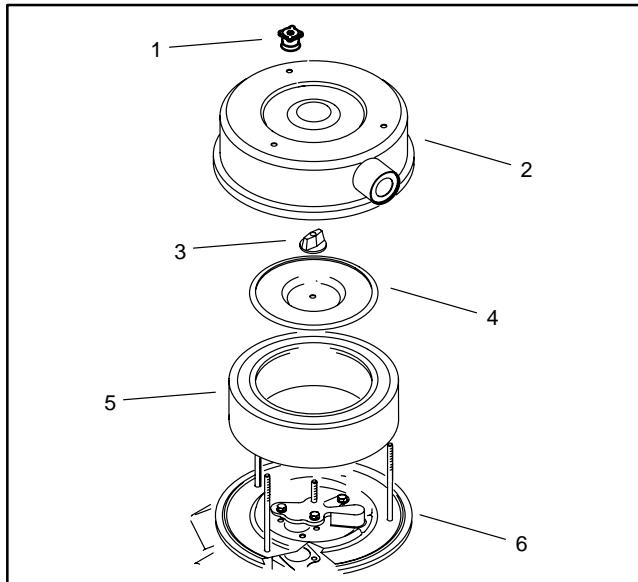


Figure 7

1. Knob
2. Cover
3. Knob

4. Cover plate
5. Filter element
6. Air cleaner base

Service Remote Air Cleaner

Inspect air cleaner filter element every 100 hours of operation. Replace every 400 hours or when dirty or damaged.

1. Check air cleaner body and body for damage that could cause possible air leaks. Replace damaged air cleaner body or cover (see Remote Air Cleaner Removal and Installation).
2. Release latches securing air cleaner cover to air cleaner body. Separate cover from the body. Clean inside of the air cleaner cover.
3. Wash filter element with soap and water as follows:
 - A. Prepare a solution of filter cleaner and water. Soak filter element about 15 minutes. See filter cleaner carton for detailed instructions.
 - B. After soaking filter for 15 minutes, rinse it with clear water. Maximum water pressure must not exceed 40 psi to prevent damage to the filter element. Rinse filter element from clean side to dirty to side.
 - C. Dry filter element using warm, flowing air not exceeding 160°F, or allow element to air-dry. Do not use a light bulb to dry the filter element because damage may result.



CAUTION

Use eye protection such as goggles when using compressed air.

4. Clean filter element with compressed air as follows:
 - A. Blow compressed air from the inside to the outside of the dry filter element. Do not exceed 100 psi to prevent damage to the element.
 - B. Keep air hose nozzle at least 2 inches from the filter. Move nozzle up and down while rotating the filter element. Inspect for holes and tears by looking through the filter toward a bright light.
5. Inspect new filter element for shipping damage. Check sealing end of element. Do not install a damaged filter element.
6. Insert new filter element properly into the air cleaner body. Make sure element is sealed properly by applying pressure to outer rim of filter when installing. Do not press on flexible center of filter.
7. Reinstall cover and secure latches. Make sure cover is positioned with TOP side up.

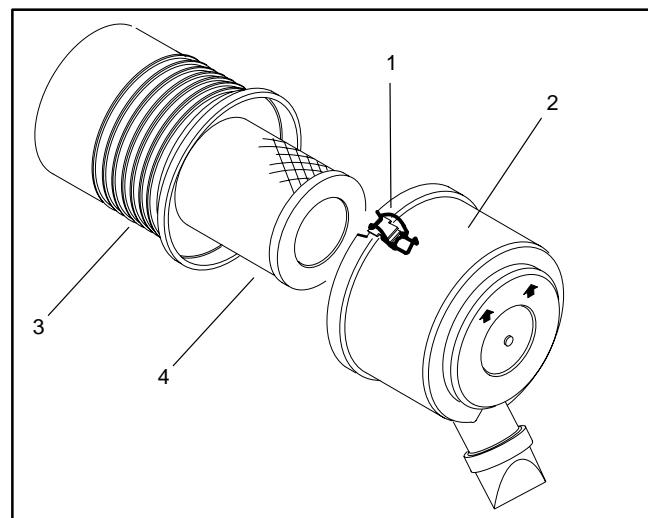


Figure 8

1. Latch
2. Cover
3. Body
4. Filter element

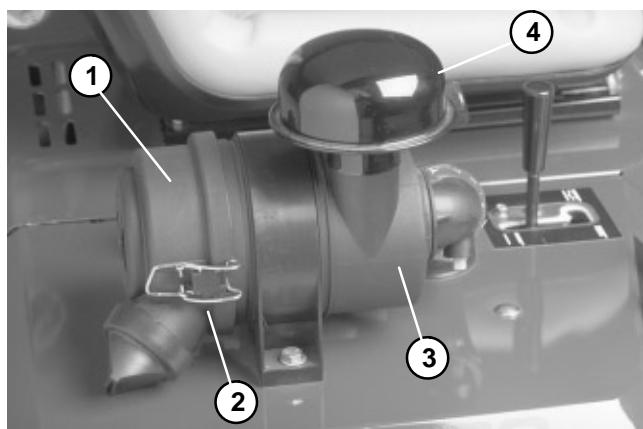


Figure 9

1. Latch
2. Cover
3. Body
4. Air inlet hood

Throttle and Choke Controls

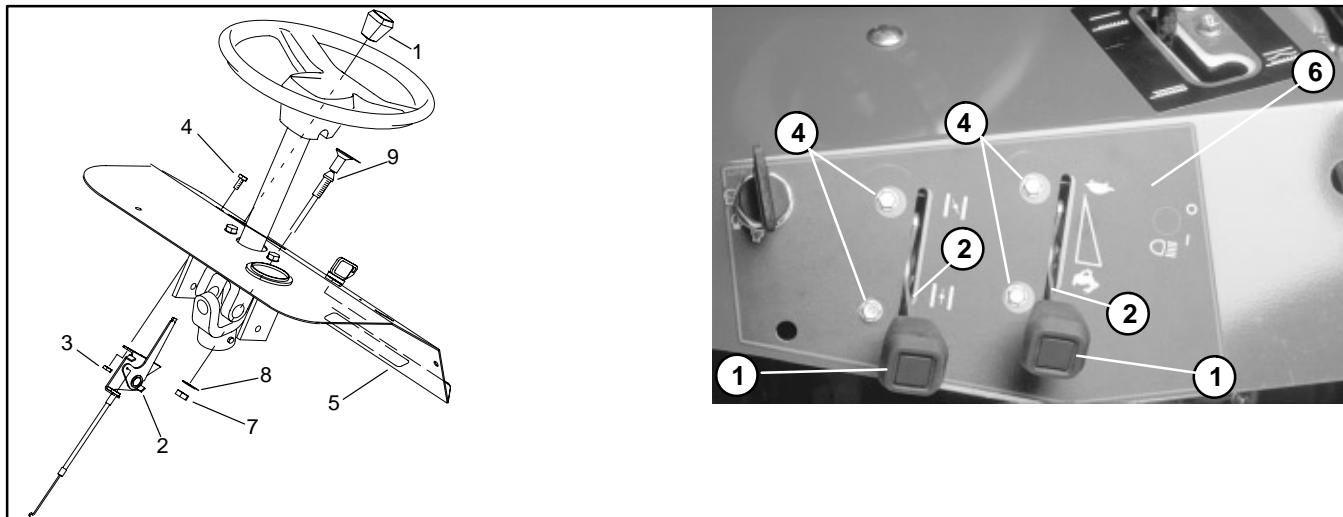


Figure 10

- | | | |
|---------------------|------------------------------|------------------|
| 1. Knob | 4. Cap screw | 7. Hex nut |
| 2. Throttle control | 5. Dash Panel (SP 2020/3020) | 8. Lock Washer |
| 3. Lock nut | 6. Right fender (SP 5020) | 9. Choke control |

Throttle Control Removal

1. Park machine on a level surface, lower attachment, stop engine, engage parking brake, and remove key from the ignition switch.
2. Pivot seat up. On the **SP 2020/3020**, remove the engine shield.
3. On the **SP 2020/3020** remove three hex flange head screws securing the hood to the front shield (Fig. 11). Remove four cap screws securing the dash panel to the hood (Fig. 12). Remove hood from the machine.
4. Release throttle cable from clamp securing it to the engine. Disconnect throttle cable from the swivel on the engine (Fig. 13).
5. Remove throttle knob from the throttle control. Remove both lock nuts and cap screws securing the throttle control to the dash panel or right fender. Remove throttle control from the machine (Fig. 10).

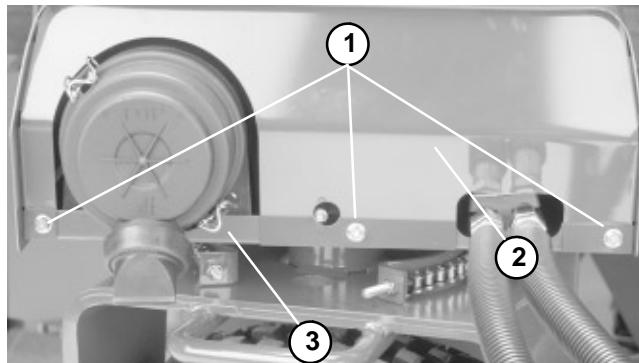


Figure 11

- | | |
|--------------------------|-----------------|
| 1. Hex flange head screw | 3. Front shield |
| 2. Hood | |

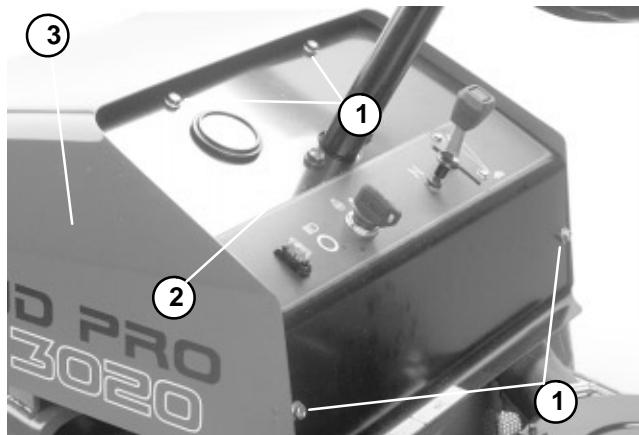


Figure 12

- | | |
|---------------|---------|
| 1. Cap screws | 3. Hood |
| 2. Dash panel | |

Throttle Control Installation

- Secure throttle control to the dash panel or right fender with both cap screws and lock nuts. Install throttle control knob to the throttle control lever (Fig. 10).
- Connect throttle cable to the swivel on the engine. Attach cable to engine with clamp. Make sure not to tighten cap screw securing clamp and cable to engine (Fig. 13).
- On the **SP 2020/3020**, position hood to the dash panel and front shield. Secure hood to front shield with three hex flange head screws (Fig. 11). Secure dash panel to hood with four cap screws (Fig. 12).
- Adjust throttle control (see Adjust Throttle Control). Install cover over the engine.

Choke Control Removal

- Park machine on a level surface, lower attachment, stop engine, engage parking brake, and remove key from the ignition switch.
- Pivot seat up. On the **SP 2020/3020**, remove the engine shield.
- On the **SP 2020/3020** remove three hex flange head screws securing the hood to the front shield (Fig. 11). Remove four cap screws securing the dash panel to the hood (Fig. 12). Remove hood from the machine.
- Remove air hose from air cleaner cover. Remove air cleaner cover. Remove cover plate and air cleaner element from the air cleaner base (Fig. 14).

NOTE: Newer engine models will have a different carburetor shield that has five hex head flange screws securing the shield and air cleaner base to the carburetor.

- Remove two cap screws and three hex head flange screws securing air cleaner base to the carburetor. Remove base carefully from carburetor. Make sure not to damage carburetor gasket. Cover carburetor to prevent dirt and debris from entering (Fig. 15).
- Release choke cable from clamp securing it to the engine. Disconnect choke cable from the choke pivot lever on the engine (Fig. 16).
- On the **SP 2020/3020** remove hex nut and lock washer securing the choke control to the dash panel. Pull choke control and cable from dash panel (Fig. 10).
- On the **SP 5020**, remove choke knob from the choke control. Remove both lock nuts and cap screws securing the choke control to the right fender. Remove choke control from the machine (Fig. 10).

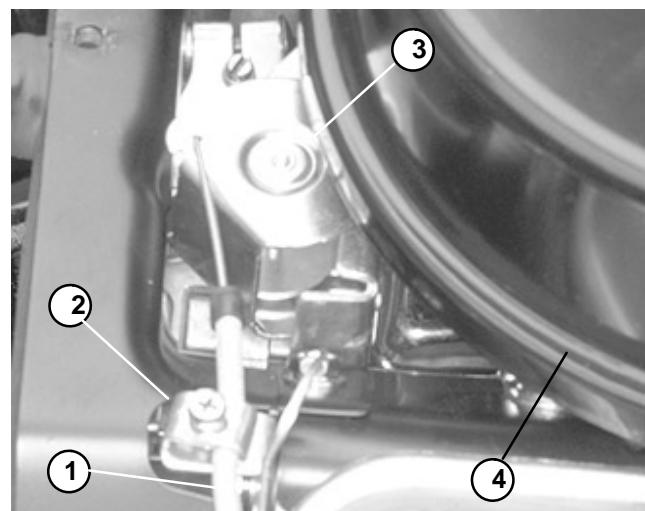


Figure 13

1. Throttle cable
2. Clamp
3. Swivel
4. Air cleaner

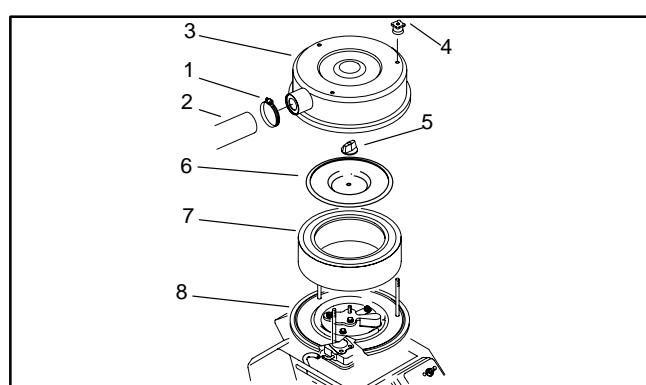


Figure 14

1. Hose clamp
2. Air hose
3. Air cleaner cover
4. Air cleaner knob
5. Air cleaner knob
6. Cover plate
7. Air cleaner element
8. Air cleaner base

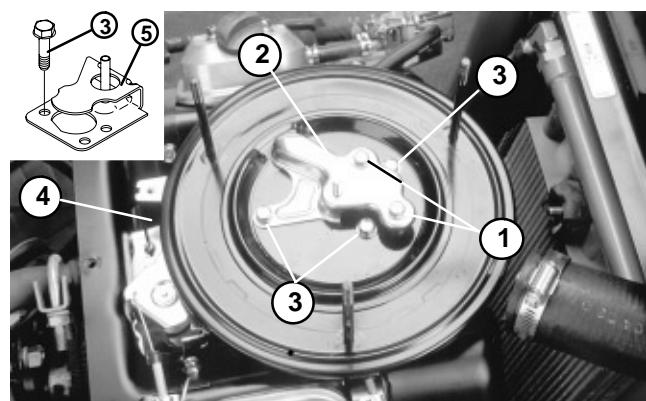


Figure 15

1. Cap screw
2. Carburetor shield
3. Hex head flange screw
4. Air cleaner base
5. Carburetor shield (newer models)

Choke Control Installation

- On the **SP 2020/3020** insert choke cable and control through the dash panel. Secure choke control to the panel with lock washer and hex nut (Fig. 10).
- On the **SP 5020**, secure choke control to the dash panel or right fender with both cap screws and lock nuts. Install knob to the choke control lever (Fig. 10).
- Connect choke cable to the choke pivot lever. Attach cable to engine with clamp. Make sure not to tighten cap screw securing clamp and cable to engine (Fig. 16).
- Remove any covering protecting the carburetor inlet. Install air cleaner base carefully to carburetor. **Make sure not to damage carburetor gasket while installing base** (Fig. 15).

NOTE: Newer engine models will have a different carburetor shield that has five hex head flange screws securing the shield and air cleaner base to the carburetor.

- Secure air cleaner base and carburetor shield to the carburetor with two cap screws and three hex head flange screws (Fig. 15).

Replace Fuel Filter

The fuel filter on the **SP 2020/3020** can be accessed from the rear of the machine. It is located just left of the hydrostat (Fig. 17). The fuel filter on the **SP 5020** can be accessed by pivoting up the seat up. It is located just forward and right of the engine (Fig. 18).

An in-line filter is incorporated into the fuel line. Change filter every 800 hours. Use the following procedure when replacement becomes necessary:

- Close fuel shutoff valve.



CAUTION

Since gasoline is highly flammable, drain it outdoors and make sure engine is cool to prevent a potential fire hazard. Wipe up any gasoline that may have spilled. Do not drain gasoline near any open flame or where gasoline fumes may be ignited by a spark. Do not smoke a cigar, cigarette, or a pipe when handling gasoline.

- Clamp both fuel hoses connected to the fuel filter so gasoline cannot drain when hoses are removed. Loosen hose clamps. Pull fuel hoses off the filter.
- Secure new filter to hoses with hose clamps. Make sure arrow on the side of filter points toward the carburetor. Remove clamps that were used to prevent drainage.

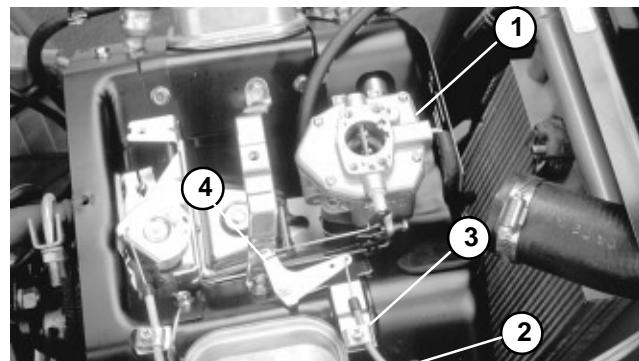


Figure 16

- 1. Carburetor
- 2. Choke cable
- 3. Clamp
- 4. Choke pivot lever

- Install air cleaner element and cover plate to the air cleaner base. Secure air cleaner cover to air cleaner. Secure air hose to air cleaner cover. (Fig. 14).
- Position hood to the dash panel and front shield. Secure hood to front shield with three hex flange head screws (Fig. 11). Secure dash panel to hood with four cap screws (Fig. 12).
- Adjust choke control (see Adjust Choke Control). Install cover over the engine.

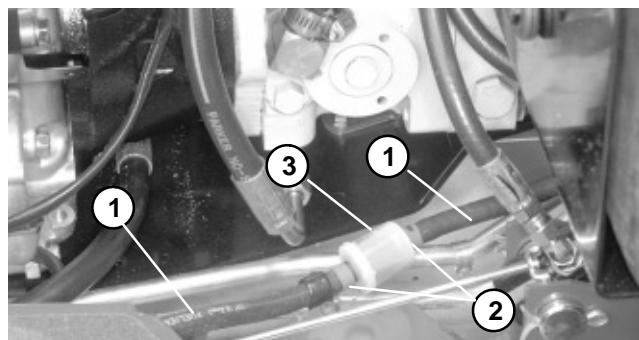


Figure 17

- 1. Fuel hose
- 2. Hose clamp
- 3. Fuel filter

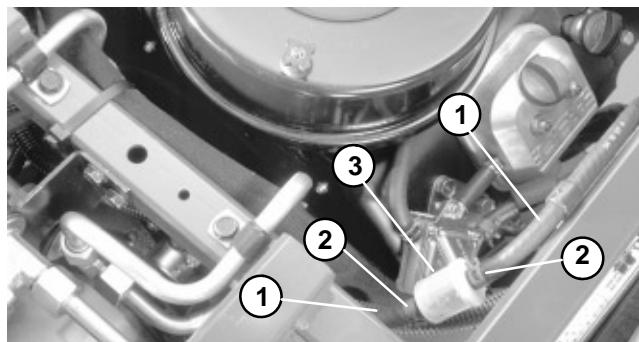


Figure 18

- 1. Fuel hose
- 2. Hose clamp
- 3. Fuel filter

Remote Air Cleaner (SP 2020/3020)

Remote Air Cleaner Removal

1. Park machine on a level surface, lower attachment, stop the engine, engage parking brake, and remove the key from the ignition switch.
2. Remove three cap screws securing the hood to the front shield (Fig 19). Remove four cap screws securing the dash panel to the hood (Fig. 20).
3. Loosen hose clamp. Remove air hose from the air cleaner body (Fig. 21).
4. Remove both lock nuts, flat washers, and cap screws securing the mounting band to the front shield (Fig. 21).
5. Unlatch and remove cover from filter body. Separate filter body from the mounting band. Make sure not to drop the filter element (Fig. 21).

Remote Air Cleaner Installation

1. Insert filter body through the mounting band. Install and latch cover to the filter body (Fig. 21).
2. Secure mounting band and air cleaner to the front shield with both cap screws, flat washers, and lock nuts (Fig. 21).
3. Secure air hose to the air cleaner with hose clamp (Fig. 21).
4. Position hood to the front shield. Position dash panel to the hood. Secure dash panel to the hood with four cap screws (Fig. 20). Secure hood to the front shield with three cap screws (Fig 19).

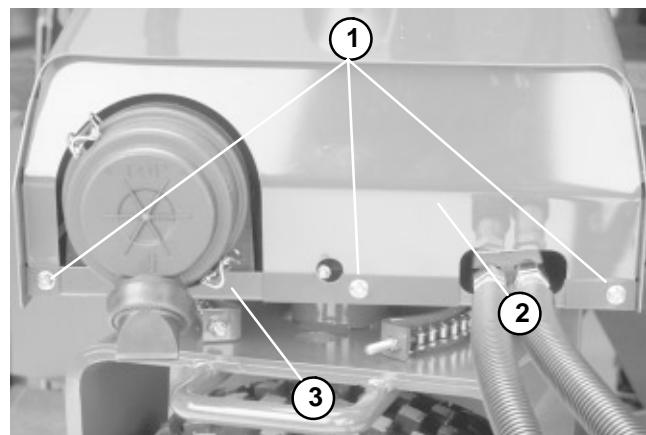


Figure 19

1. Hex flange head screw 3. Front shield
2. Hood

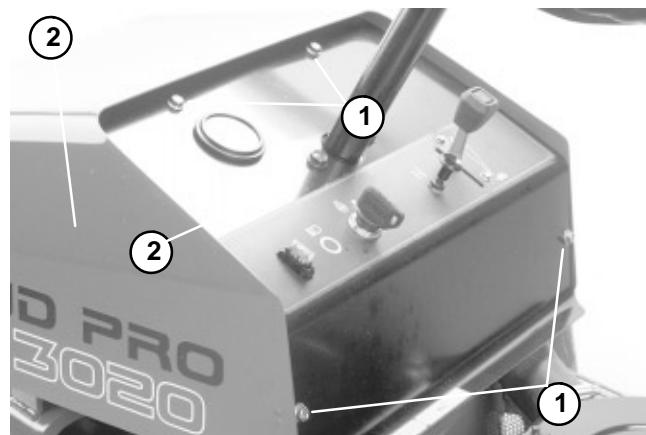


Figure 20

1. Cap screws 3. Hood
2. Dash panel

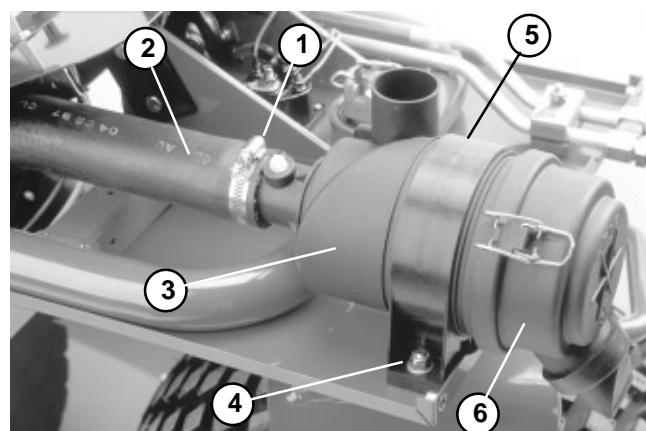


Figure 21

1. Hose clamp 4. Lock nut & flat washer
2. Air hose 5. Mounting band
3. Air cleaner body 6. Cover

Remote Air Cleaner (SP 5020)

Remote Air Cleaner Removal

1. Park machine on a level surface, lower attachment, stop the engine, engage parking brake, and remove the key from the ignition switch.
2. Loosen hose clamp. Remove air cleaner hose from the air cleaner body.
3. Remove both lock nuts, flat washers, and cap screws securing the mounting band to the right fender.
4. Unlatch and remove cover from air cleaner body. Separate body from the mounting band. Make sure not to drop the filter element.

Remote Air Cleaner Installation

1. Insert air cleaner body through the mounting band. Make sure filter element is inside the body. Install and latch cover to the air cleaner body.
2. Secure mounting band and air cleaner to the front shield with both cap screws, flat washers, and lock nuts.
3. Secure air hose to the air cleaner with hose clamp.

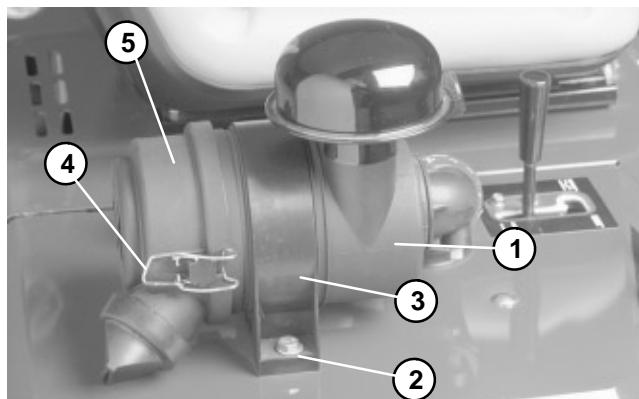


Figure 22

- | | |
|----------------------------|----------|
| 1. Body | 4. Latch |
| 2. Cap screw & flat washer | 5. Cover |
| 3. Mounting band | |

Muffler (SP 5020)

Muffler Removal

- Park machine on a level surface, lower attachment, stop the engine, engage parking brake, and remove the key from the ignition switch.



CAUTION

The muffler and exhaust pipe may be hot. To avoid possible burns, allow engine and exhaust system to cool before working on the muffler.

- Access muffler from the rear of the machine. Remove muffler shield from the engine by removing three cap screws and lock washers securing it to the engine (Fig. 23 and 24).
- Remove cap screws securing muffler and both gaskets to the cylinder heads. Pull muffler from the engine (Fig. 24 and 25).

Muffler Installation

- Replace gaskets if torn or damaged. Replace exhaust detector if worn or damaged.
- Secure gaskets and muffler to cylinder heads with cap screws (Fig. 24 and 25).
- Secure muffler shield to the engine with three cap screws and lock washers (Fig. 23 and 24).

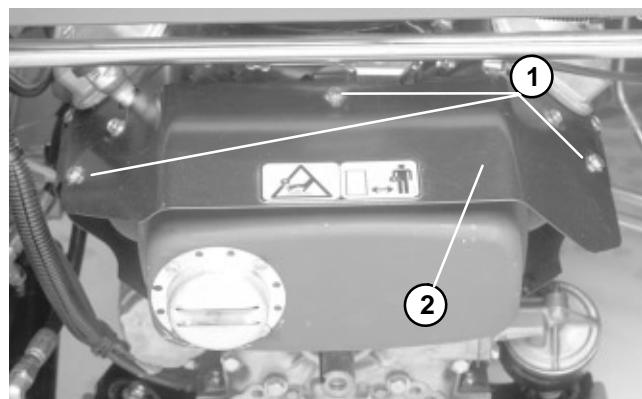


Figure 23

1. Cap screw & lock washer 2. Muffler shield

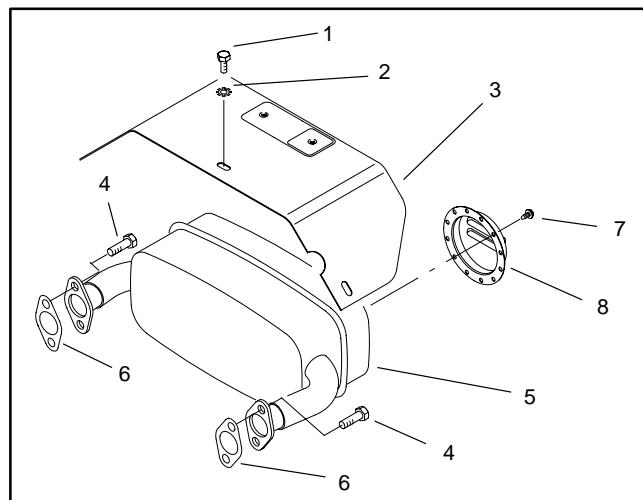


Figure 24

- | | |
|-------------------|----------------------|
| 1. Cap screw | 5. Muffler |
| 2. Lock washer | 6. Gasket |
| 3. Muffler shield | 7. Screw |
| 4. Cap screw | 8. Exhaust deflector |

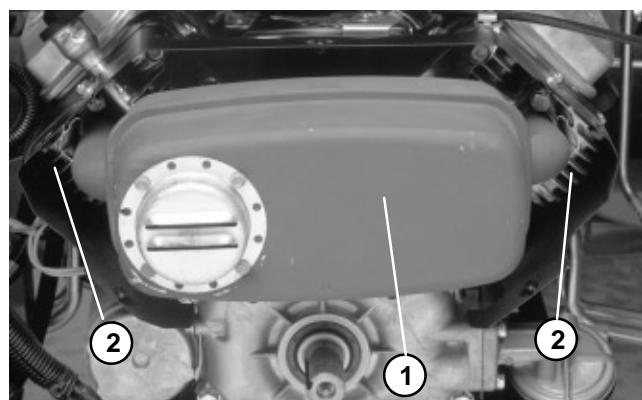


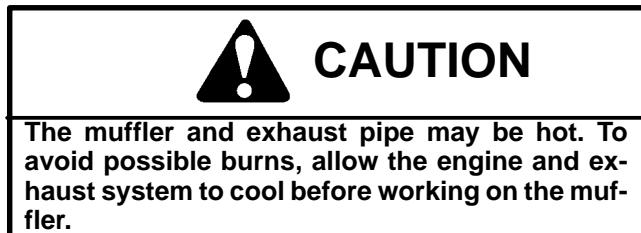
Figure 25

1. Muffler 2. Cylinder head

Muffler (SP 2020/3020)

Muffler Removal

1. Park machine on a level surface, lower attachment, stop the engine, engage parking brake, and remove the key from the ignition switch.
2. Chock front wheel to prevent machine from moving with both rear wheels jacked up. Jack up rear wheels enough to allow the muffler to be removed through the bottom of the machine. Block up rear wheels (See Jacking Instructions in Chapter 1 – Safety).



3. Remove knob from the lift lever. Remove both lock nuts and cap screws securing the lift valve shroud, lift lever guide, and lift lever latch (Fig. 26).
4. Remove bottom front cap screw securing the lift valve shroud to the frame. Pull shroud from the frame (Fig. 26).
5. Remove cotter pins from both adjusting rods. Separate adjusting rods from both brake arms (Fig. 27).
6. Remove cotter pin from the brake rod. Separate brake rod from the traverse rod lever (Fig. 28).
7. Loosen both hex flange head screws and lock nuts on each side flange bearing. Lower traverse rod from the frame (Fig. 28).
8. Remove three cap screws and star washers securing the muffler shield, R-clamp, and fuel hose to the engine (Fig. 29).
9. Remove hex nut, cap screw, flat washer securing the muffler tab to the muffler bracket (Fig. 30).
10. Remove both muffler clamps securing the exhaust tube to the muffler and exhaust manifold (Fig. 31).
11. Separate exhaust tube from the exhaust manifold. Separate exhaust tube from the muffler. Remove muffler through the bottom of the machine (Fig. 31).

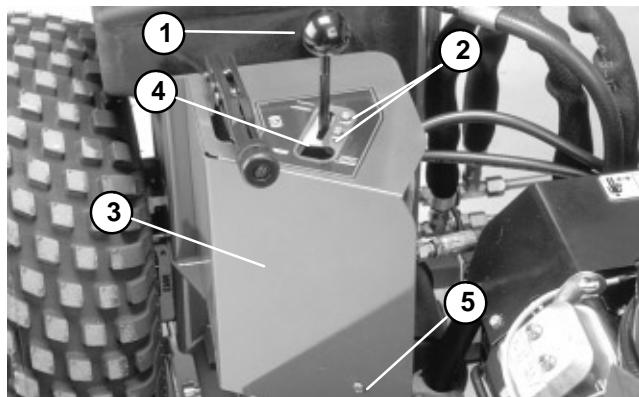


Figure 26

1. Knob
2. Lock nut & cap screw
3. Lift valve shroud
4. Lift lever guide & latch
5. Cap screw

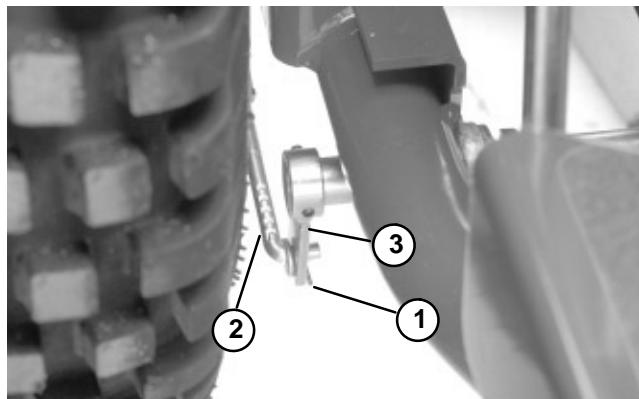


Figure 27

1. Cotter pin
2. Adjusting rod
3. Brake arm

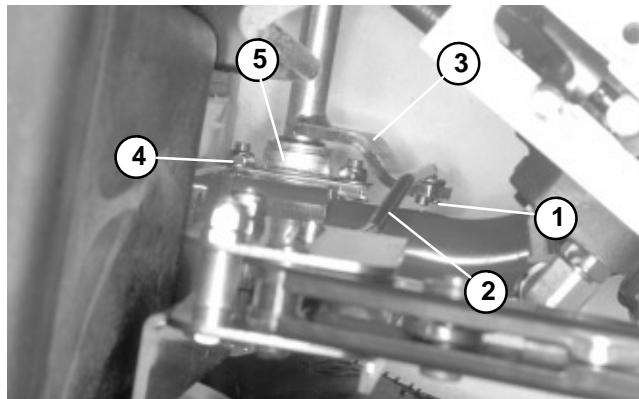


Figure 28

1. Cotter pin
2. Brake rod
3. Traverse rod lever
4. Lock nut
5. Flange bearing

Muffler Installation

1. Position muffler through the bottom of the machine to the muffler bracket. Insert cap screw with flat washer through the muffler tab and then the muffler bracket. Screw hex nut onto the cap screw, but do not tighten (Fig. 30).
2. Attach exhaust tube to the muffler. Attach exhaust tube to the exhaust manifold (Fig. 31).
3. Make sure exhaust tube fits snugly to both the muffler and exhaust manifold. Secure exhaust tube to the exhaust manifold and muffler with muffler clamps (Fig. 31).
4. Tighten cap screw and hex nut securing the muffler to the muffler bracket (Fig. 30).
5. Secure R-clamp and muffler shield to the engine with three cap screws and star washers (Fig. 29).
6. Position traverse rod to the frame. Make sure each side flange bearing is on the inside of the frame. Secure bearings to the frame by tightening both hex flange head screws on each bearing (Fig. 28).
7. Connect brake rod to the traverse rod lever. Secure brake rod with cotter pin (Fig. 28).
8. Connect adjusting rods to both brake arms. Secure both adjusting rods with a cotter pin (Fig. 27).
9. Secure top of lift valve shroud, lift lever guide, and lift lever latch to the frame with both cap screws and lock nuts. Make sure nylon lift lever guide is placed on top of metal lift lever latch (Fig. 26).
10. Secure bottom of shroud to frame with cap screw. Screw knob onto lift lever (Fig. 26).
11. Lower rear wheels to the ground after removing blocks.

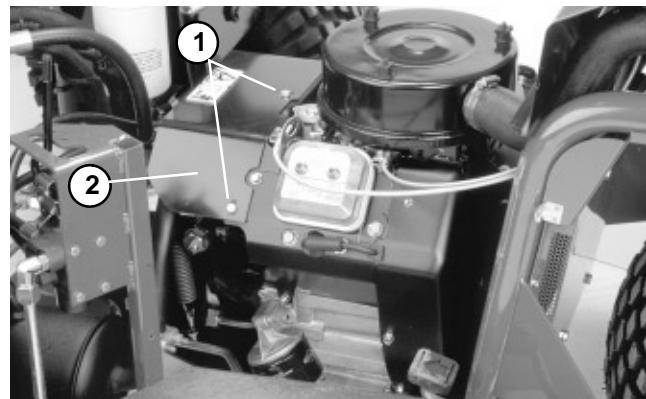


Figure 29

1. Cap screw & star washer 2. Muffler shield

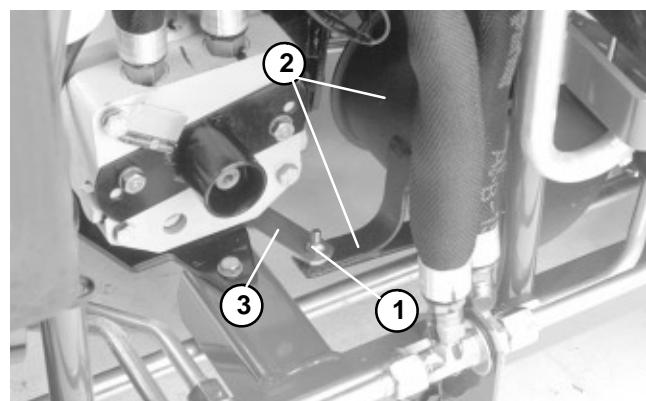


Figure 30

1. Lock nut & cap screw 2. Muffler 3. Muffler bracket

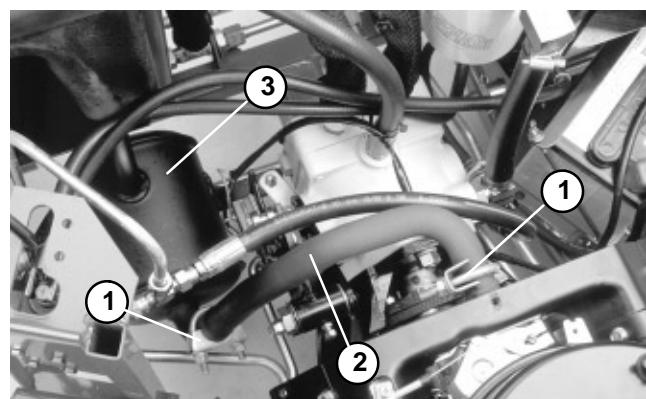


Figure 31

1. Muffler clamps 2. Exhaust tube 3. Muffler

Fuel Tank (SP 2020/3020)

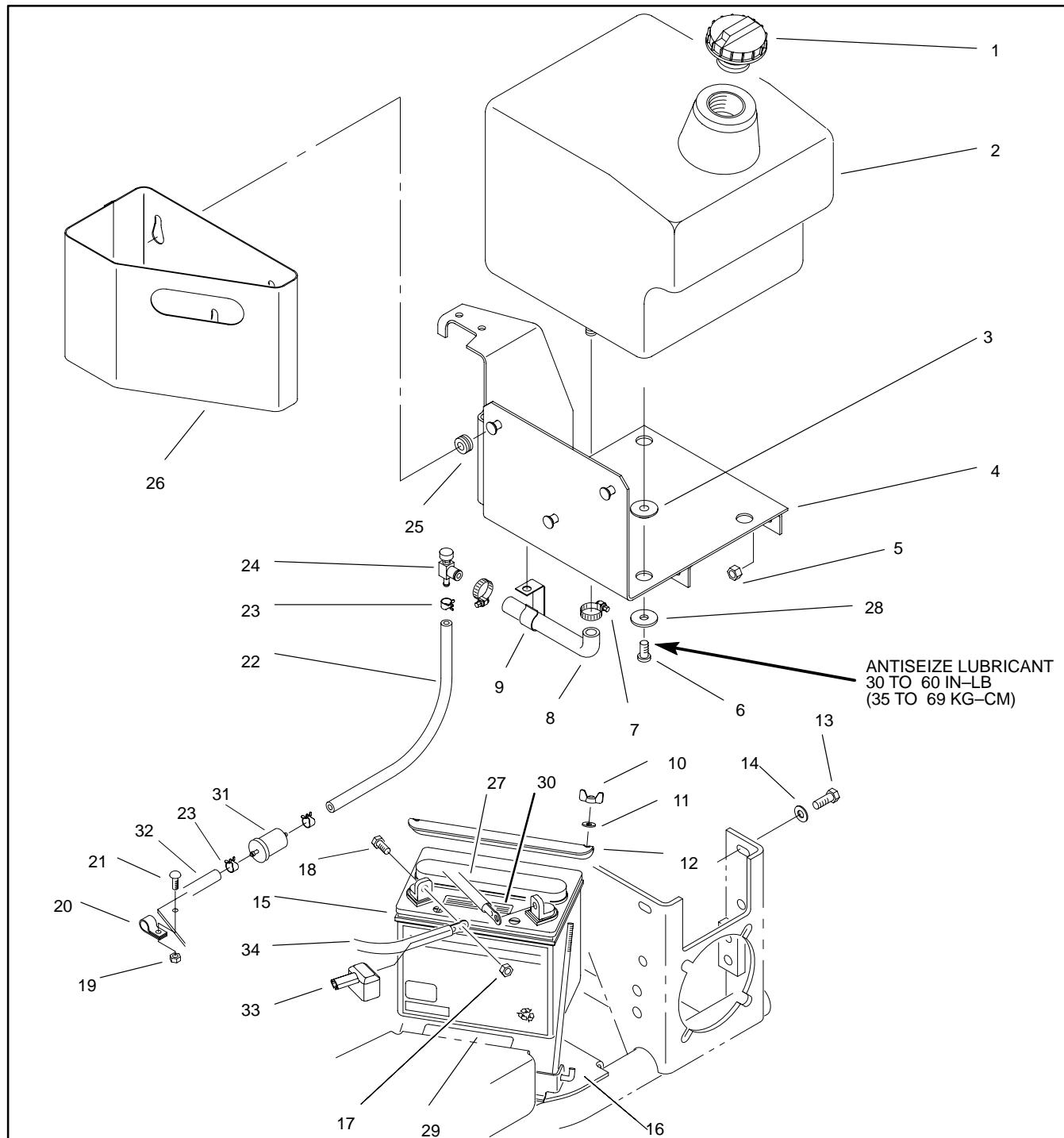


Figure 32

- | | | |
|---------------------------|------------------------------|-----------------------------------|
| 1. Fuel cap | 13. Cap screw | 24. Fuel shutoff valve |
| 2. Fuel tank | 14. Flat washer | 25. Grommet |
| 3. Grommet | 15. Battery | 26. Litter box |
| 4. Fuel tank base | 16. Battery bolt | 27. Battery wire (ground) |
| 5. Lock nut | 17. Lock nut | 28. Flat washer |
| 6. Philips pan head screw | 18. Cap screw | 29. Battery decal |
| 7. Hose clamp | 19. Lock nut | 30. Danger decal |
| 8. Fuel hose | 20. R-clamp | 31. Fuel filter |
| 9. Fuel hose clip | 21. Socket button head screw | 32. Fuel hose |
| 10. Wing nut | 22. Fuel hose | 33. Terminal boot |
| 11. Flat washer | 23. Hose clamp | 34. Battery wire (start solenoid) |
| 12. Battery clamp | | |

Fuel Tank Removal (Fig. 32)

1. Park machine on a level surface, lower attachment, stop the engine, engage parking brake, and remove the key from the ignition switch.
2. Pivot seat up. Remove litter box (26) from the frame.
3. Disconnect and remove battery from the machine to prevent possible spillage of fuel on the battery (see Battery Service in Chapter 5 – Electrical Systems).



DANGER

Gasoline is flammable. Use caution when storing or handling it. Do not drain fuel tank while the engine is running, or when the machine is in an enclosed area. Vapors may build up and be ignited by a spark or flame source many feet away. DO NOT SMOKE while draining the fuel tank to prevent the possibility of an explosion. Always drain fuel tank outside. Wipe up any spilled gasoline. Store gasoline in a clean, safety-approved container, and secure cap on the container. Keep gasoline in a cool, well ventilated place and never in an enclosed area such as a hot storage shed. Since many children like the smell of gas, keep it out of their reach because the fumes are explosive and dangerous to inhale.

4. Drain fuel tank (2) as follows:
 - A. Close fuel shutoff valve (24).
 - B. Disconnect fuel hose (22) from the fuel filter (31). Use funnel and hose to drain the fuel into a suitable container for storage.
 - C. Drain fuel tank completely by opening the fuel shutoff valve. Close fuel shutoff valve when tank is drained.
5. Loosen hose clamp (7) and disconnect fuel hose (8) from the bottom of the fuel tank (2).
6. Remove four philips pan head screws (6) and flat washers (28) securing the fuel tank (2) to the fuel tank base (4).
7. Lift fuel tank (2) from fuel tank base (4). Make sure not to lose grommets (3).
8. If the fuel tank base (4) is to be removed,
 - A. Remove both cap screws and lock washers securing the filter head to the base (Fig. 33).
 - B. Remove three lock nuts, cap screws, and flat washers securing the base to the frame.

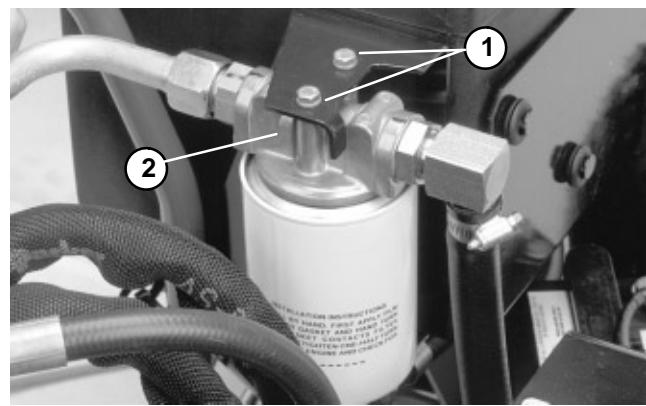


Figure 33

1. Cap screw & lock washer 2. Filter head

Fuel Tank installation (Fig. 32)

1. If the fuel tank base (4) was removed,
 - A. Secure fuel tank base (4) to the frame with three cap screws (13), flat washers (14), lock nuts (5).
 - B. Securing filter head to the base with both cap screws and lock washers (Fig. 33).
2. Position fuel tank (2) to the fuel tank base (4).
 - A. Apply antiseize lubricant to the threads of the four philips pan head screws (6).
 - B. Make sure grommets (3) are in place. Secure fuel tank to the base with four flat washers (4) and pan head screws.
 - C. Torque cap screws from 30 to 60 in-lb (35 to 69 kg-cm).
3. Connect and secure fuel hose (8) to the fuel tank (2) with hose clamp (7).
4. Connect and secure fuel hose (22) to the fuel filter (31) with hose clamp (23).
5. Open fuel shutoff valve (9) below the fuel tank.
6. Install and connect battery to the machine (see Battery Service in Chapter 5 – Electrical Systems).
7. Install litter box (26) to the frame. Pivot seat down.
8. Fill fuel tank with fuel (see Fill fuel Tank). Check fuel lines and tank for leaks.

Fuel Tank (SP 5020)

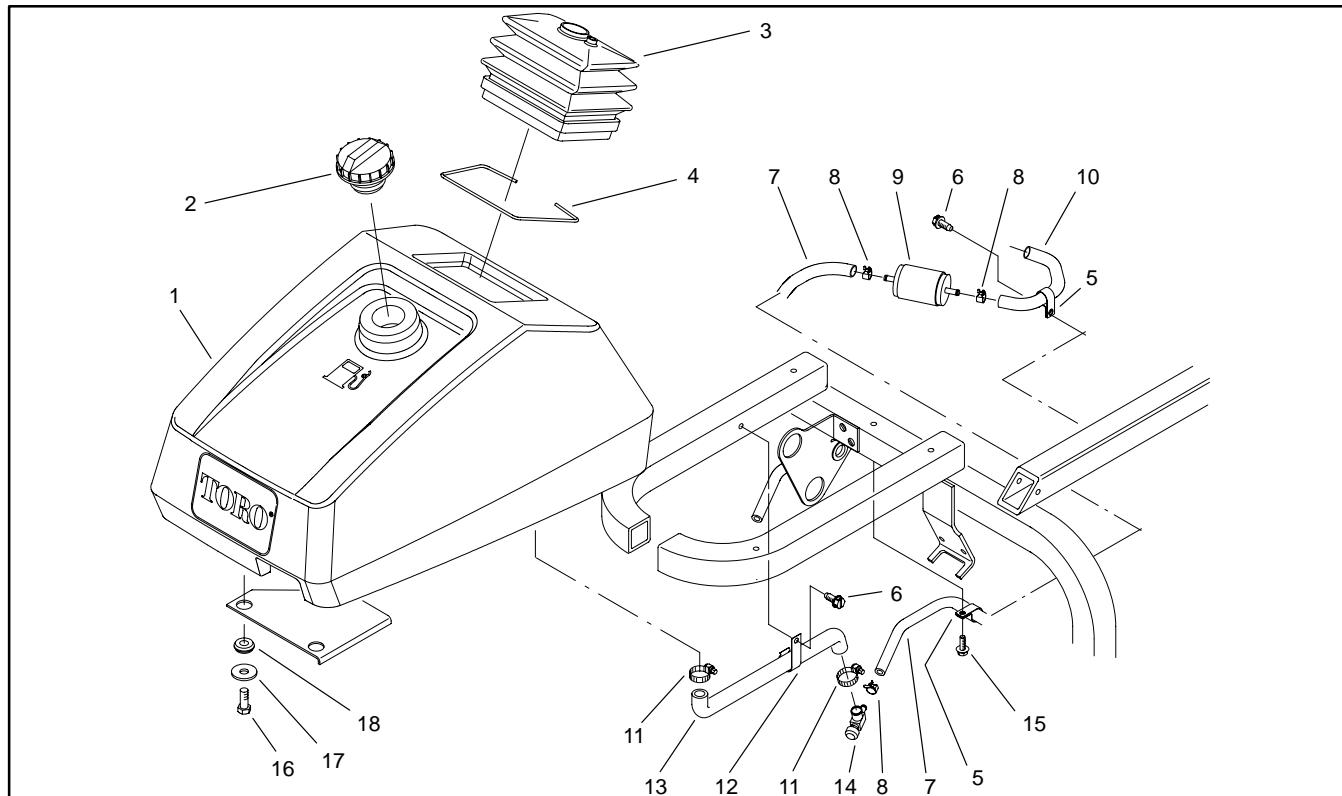


Figure 34

- | | | |
|-----------------------|----------------|------------------------|
| 1. Fuel tank | 7. Fuel hose | 13. Fuel hose |
| 2. Fuel cap | 8. Hose clamp | 14. Fuel shutoff valve |
| 3. Steering boot | 9. Fuel filter | 15. Whiz cap screw |
| 4. Boot retainer | 10. Fuel hose | 16. Cap screw |
| 5. R-clamp | 11. Hose clamp | 17. Flat washer |
| 6. Self tapping screw | 12. R-clamp | 18. Grommet |

Fuel Tank Removal (Fig. 34)

- Park machine on a level surface, lower attachment, stop the engine, engage parking brake, and remove the key from the ignition switch.



DANGER

Gasoline is flammable. Use caution when storing or handling it. Do not drain fuel tank while the engine is running, or when the machine is in an enclosed area. Vapors may build up and be ignited by a spark or flame source many feet away. DO NOT SMOKE while draining the fuel tank to prevent the possibility of an explosion. Always drain fuel tank outside. Wipe up any spilled gasoline. Store gasoline in a clean, safety-approved container, and secure cap on the container. Keep gasoline in a cool, well ventilated place and never in an enclosed area such as a hot storage shed. Since many children like the smell of gas, keep it out of their reach because the fumes are explosive and dangerous to inhale.

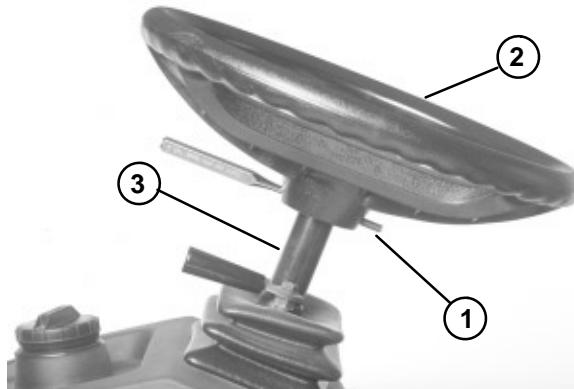


Figure 35

- | | |
|-------------------|-------------------------|
| 1. Roll pin | 3. Upper steering shaft |
| 2. Steering wheel | |
- Remove roll pin from the steering wheel and upper steering shaft with a drift punch. Remove steering wheel from the upper steering shaft (Fig. 35).

3. Remove adjustment lever from tilt lock pin by first removing cap screw (Fig. 36).

4. Drain fuel tank as follows:

A. Close fuel shutoff valve.

B. Remove self tapping screw securing the fuel hose and R-clamp to the frame.

C. Disconnect fuel hose leading from the fuel tank at the fuel shutoff valve. Use funnel and hose to drain the fuel into a suitable container for storage.

5. Remove four cap screws and flat washers securing the fuel tank to the frame.

6. Make sure not to tear the steering boot while carefully pulling the top of the boot over the tilt pin.

7. Lift fuel tank from frame. Make sure not to lose grommets.

Fuel Tank installation (Fig. 34)

1. Position fuel tank to the frame making sure not to tear the steering boot while carefully lowering the top of the boot over the tilt pin.

A. Apply antiseize lubricant to the threads of the four cap screws.

B. Make sure grommets are in place. Secure fuel tank to the frame with four flat washers and cap screws.

C. Torque cap screws from 30 to 60 in-lb (35 to 69 kg-cm).

2. Route fuel hose from the tank to the fuel shutoff valve. Connect and secure fuel hose to the shutoff valve with the hose clamp.

3. Secure R-clamp and fuel hose to the frame with self tapping screw.

4. Secure adjustment lever to tilt lock pin with cap screw (Fig. 36).

5. Install steering wheel onto the upper steering shaft. Secure steering wheel to upper steering shaft with the roll pin using a drift punch (Fig. 35).

6. Open fuel shutoff valve.

7. Fill fuel tank with fuel (see Fill fuel Tank). Check fuel lines and tank for leaks.

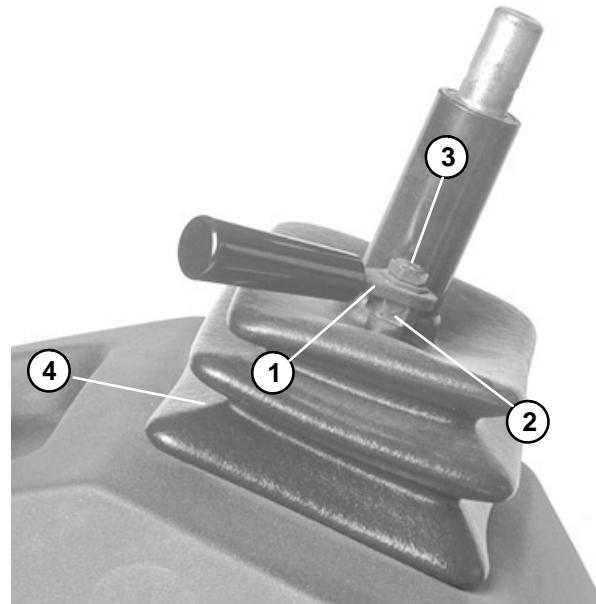


Figure 36

1. Adjustment lever
2. Tilt lock pin

3. Cap screw
4. Steering boot

Engine (SP 2020/3020)

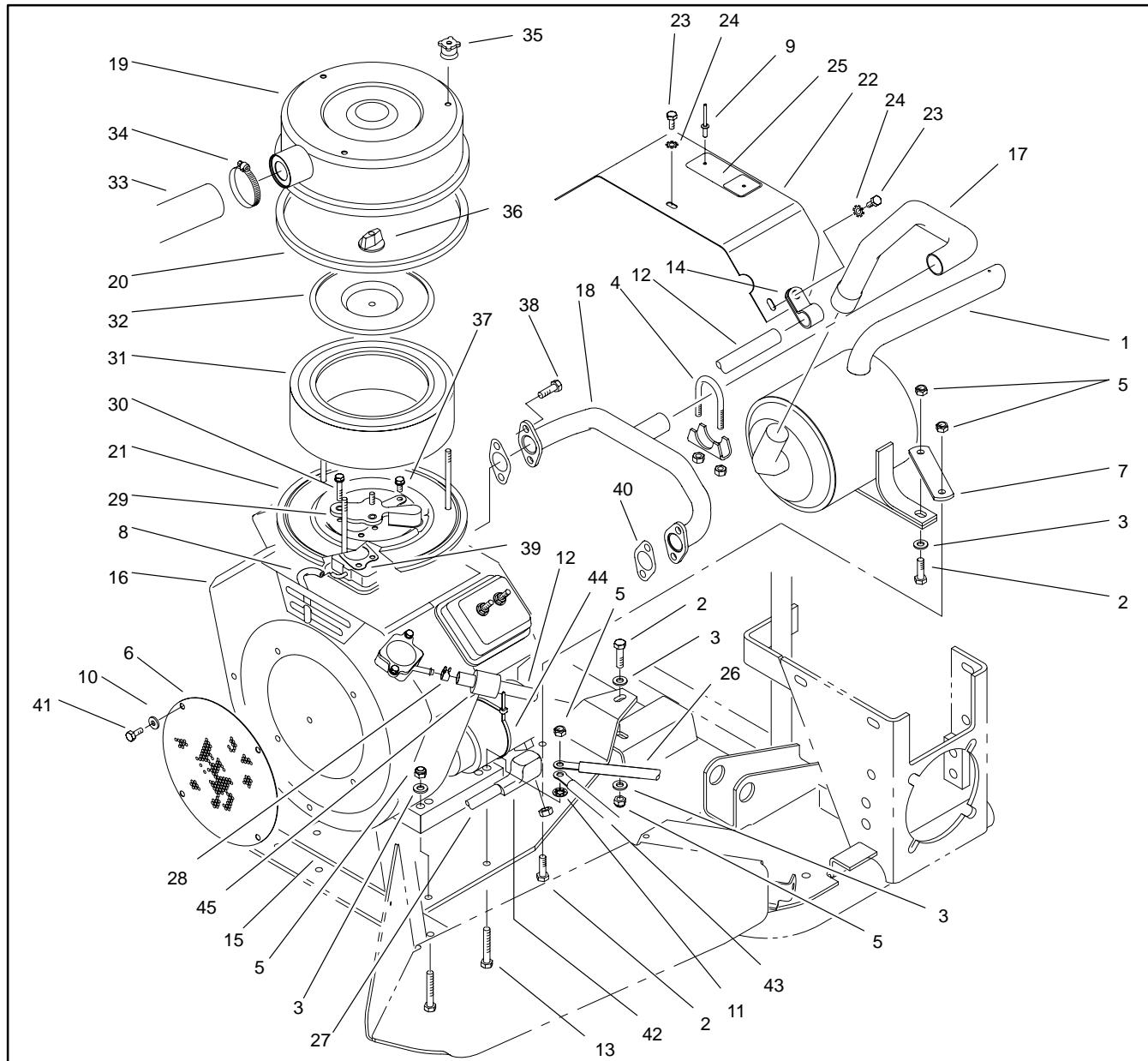


Figure 37

- | | | |
|--------------------|----------------------------------|--------------------------------|
| 1. Muffler | 16. Engine | 31. Air cleaner element |
| 2. Cap screw | 17. Exhaust tube | 32. Cover plate |
| 3. Flat washer | 18. Exhaust manifold | 33. Air hose |
| 4. Muffler clamp | 19. Air cleaner cover | 34. Hose clamp |
| 5. Hex nut | 20. Ring gasket | 35. Air cleaner knob |
| 6. Screen | 21. Air cleaner base | 36. Air cleaner knob |
| 7. Muffler bracket | 22. Muffler shield | 37. Washer face screw |
| 8. Fuel hose | 23. Cap screw | 38. Screw |
| 9. Pop rivet | 24. Lock washer | 39. Carburetor gasket |
| 10. Flat washer | 25. Hot surface plate | 40. Manifold gasket |
| 11. Lock washer | 26. Battery cable (Ground) | 41. Screw |
| 12. Fuel hose | 27. Red cable (Starter solenoid) | 42. Boot |
| 13. Cap screw | 28. Hose clamp | 43. Wire harness (Ground wire) |
| 14. R-clamp | 29. Carburetor inlet shield | 44. Cable tie |
| 15. Engine base | 30. Screw | 45. Bumper |

Engine Removal (Fig. 37)

1. Park machine on a level surface, lower attachment, stop engine, engage parking brake, and remove key from the ignition switch.
2. Pivot seat up. Remove engine cover. Remove move litter box from fuel tank base.
3. Disconnect and remove battery from the machine to prevent the possibility of the engine dropping on it (see Battery Service in Chapter 5 – Electrical Systems).
- NOTE:** Do not disconnect brake linkages or remove traverse rod when disconnecting the exhaust tube (17) and muffler (1) from the engine (16).
4. Separate exhaust tube (17) and muffler (1) from the exhaust manifold (see Muffler Removal).
5. Close fuel shutoff located below the fuel tank. Clamp fuel hose (12) near engine (16) to prevent fuel spillage. Loosen hose clamp (28) and remove fuel hose (12) from the engine.
6. Remove cable tie from the starter and wire harness. Disconnect harness as follows (Fig. 38):

- A. Disconnect blue wire from magneto terminal.
- B. Disconnect blue wire with fusible link from voltage regulator.
- C. Disconnect red/white wire from fuel solenoid.
- D. Disconnect red (+) cable from starter.
7. Remove air hose (33) from air cleaner cover (19).
8. Disconnect throttle control cable from the swivel and choke control cable from the choke lever (see Throttle and Choke Control Removal).
9. Remove cotter pin from the pump control rod. Separate rod from the pump lever (Fig. 39).
10. Loosen both set screws on the engine hub to remove hub from the pump shaft (Fig. 40).
11. Remove four cap screws and lock washers securing the pump mount to the engine block. Pull pump and mount from the engine and secure to frame. Remove square key from engine shaft (Fig. 41).
12. Remove hex nut (5), lock washer (11), and cap screw (13) securing the black (-) battery cable (26) and wire harness (43) ground wire to the engine block. Pull cable and harness clear of the engine (16).
13. Remove three hex nuts (5), flat washers (3), and cap screws (13) securing the engine (16) to its base (15).

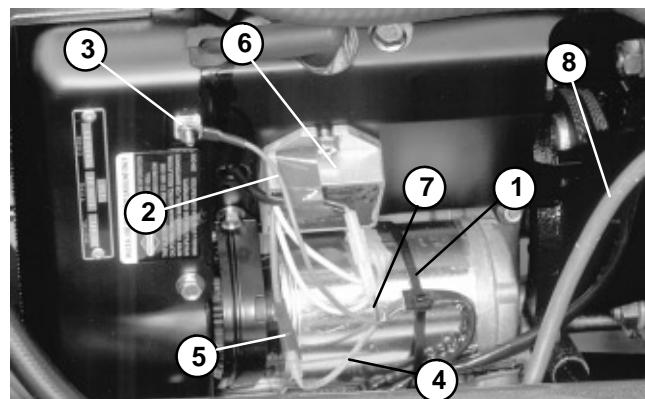


Figure 38

- | | |
|---------------------|--------------------------|
| 1. Cable on starter | 5. Fusible link |
| 2. Blue wire | 6. Voltage regulator |
| 3. Magneto terminal | 7. Red/white wire |
| 4. Blue wire | 8. Red (+) battery cable |

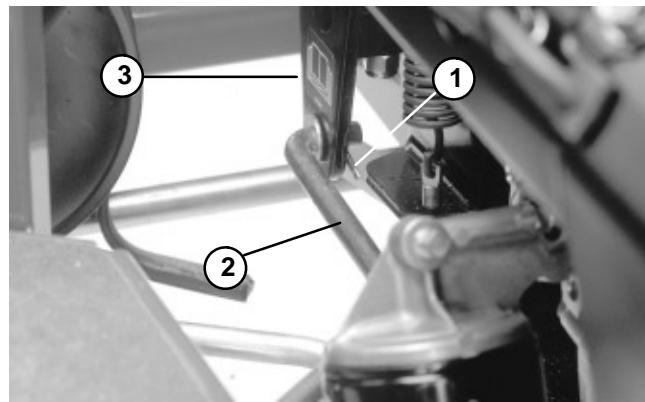


Figure 39

- | | |
|---------------------|---------------|
| 1. Cotter pin | 3. Pump lever |
| 2. Pump control rod | |

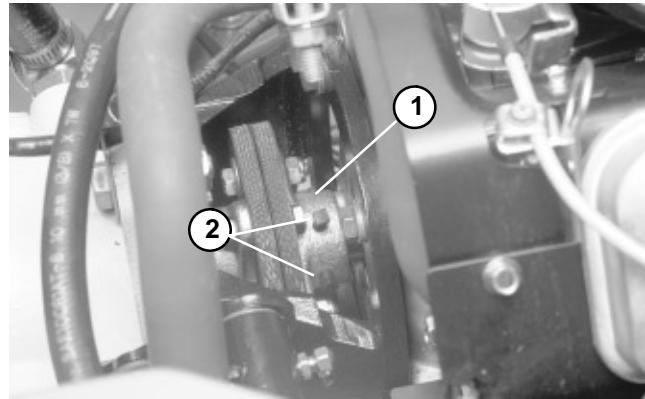


Figure 40

- | | |
|---------------|-------------------------|
| 1. Engine hub | 2. Set screw (pump hub) |
|---------------|-------------------------|

IMPORTANT: Make sure not to damage wires, wire harness, hoses, and cables are while lifting the engine from the machine.

14. Connect hoist or chain fall to the engine. Slowly remove engine from the machine.

Engine Installation (Fig. 37)



CAUTION

One person should operate the chain fall or hoist while the other person guides the engine into the frame.

1. Install engine (16) to the engine base (15).
 - A. Attach a hoist or chain fall to the engine.

IMPORTANT: Make sure not to damage the engine, fuel and hydraulic lines, electrical harness, or other parts while installing the engine.
 - B. Lower engine slowly onto the engine base.
 - C. Insert cap screw (13) through engine base and engine block. Install lock washer (11) onto cap screw with battery cable (26) and wire harness (43). Screw hex nut (5) onto the cap screw.
 - D. Insert cap screws (13) through engine base and engine block. Install flat washers (3) and screw hex nuts (5) onto the cap screws. Do not tighten fasteners at this time.
 - E. Tighten all four fasteners securing the engine to its base.
2. Place square key on the engine shaft.
3. Position pump and pump mount to the engine. Make sure engine hub slides onto the engine shaft and square key (Fig. 40). Secure pump mount to the engine block with four cap screws and lock washers (Fig. 41).
4. Tighten both set screws securing the engine hub to the engine shaft (Fig. 40).
5. Insert end of pump control rod into the pump lever. Secure rod with cotter pin (Fig. 39).
6. Connect throttle control cable to the swivel and choke control cable to the choke lever (see Throttle and Choke Control Installation).
7. Install air hose (33) to air cleaner cover (19). Secure hose with hose clamp (34).
8. Secure fuel hose (12) to the engine (16) with hose clamp (28). Remove clamp used to prevent drainage from fuel hose (12). Open fuel shutoff located below the fuel tank.
9. Connect exhaust tube and muffler to the exhaust manifold (see Muffler Installation).

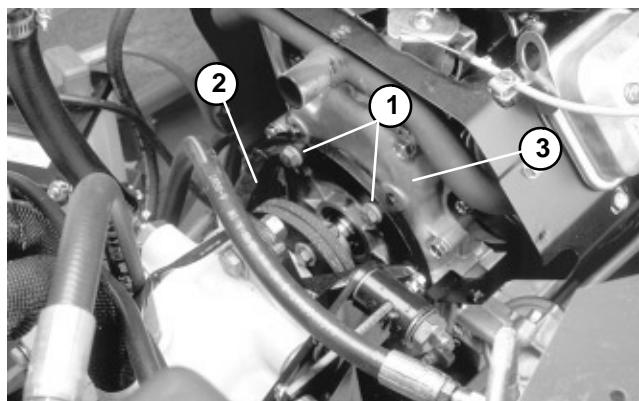


Figure 41

1. Cap screw & lock washer 3. Engine block
2. Pump mount

10. Connect harness as follows (Fig. 38):
 - A. Connect blue wire to magneto terminal.
 - B. Connect blue wire with fusible link to voltage regulator.
 - C. Connect red/white wire to fuel solenoid.
 - D. Connect red (+) cable to starter.
 - E. Secure wire harness with cable tie to the starter.
11. Install and connect battery to the machine (see Battery Service in Chapter 5 – Electrical Systems).
12. Install litter box to the fuel tank base.
13. Install engine cover. Pivot seat down.

Replace Spark Plugs

Replace spark plugs after every 800 operating hours or yearly, whichever occurs first. Recommended air gap is 0.030 inch (0.762 mm). Use a Champion RC 12YC spark plug or equivalent.

NOTE: A spark plug usually lasts a long time. However, remove. Check spark plugs whenever the engine malfunctions.

IMPORTANT: A cracked, fouled, dirty, or otherwise malfunctioning spark plug must be replaced. Do not sand blast, scrape, or clean electrodes by using a wire brush because grit may be released from the plug and fall into the cylinder. The result is usually a damaged engine.

1. Clean area around spark plugs so foreign matter cannot fall into cylinder when spark plug is removed.
2. Pull spark plug wires off spark plugs. Remove plugs from cylinder head.
3. Check condition of side electrode, center electrode, and center electrode insulator. Make sure there is no damage.

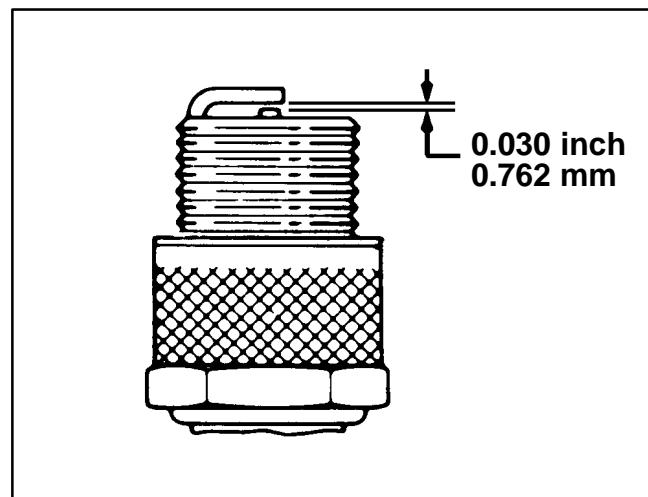


Figure 42

4. Set air gap between the center and side of the electrodes at 0.030 inch (0.762 mm). Install correctly gapped spark plug with gasket seal. Tighten spark plug to 200 in-lb (230 kg-cm). If torque wrench is not used, tighten plug firmly.

Engine (SP 5020)

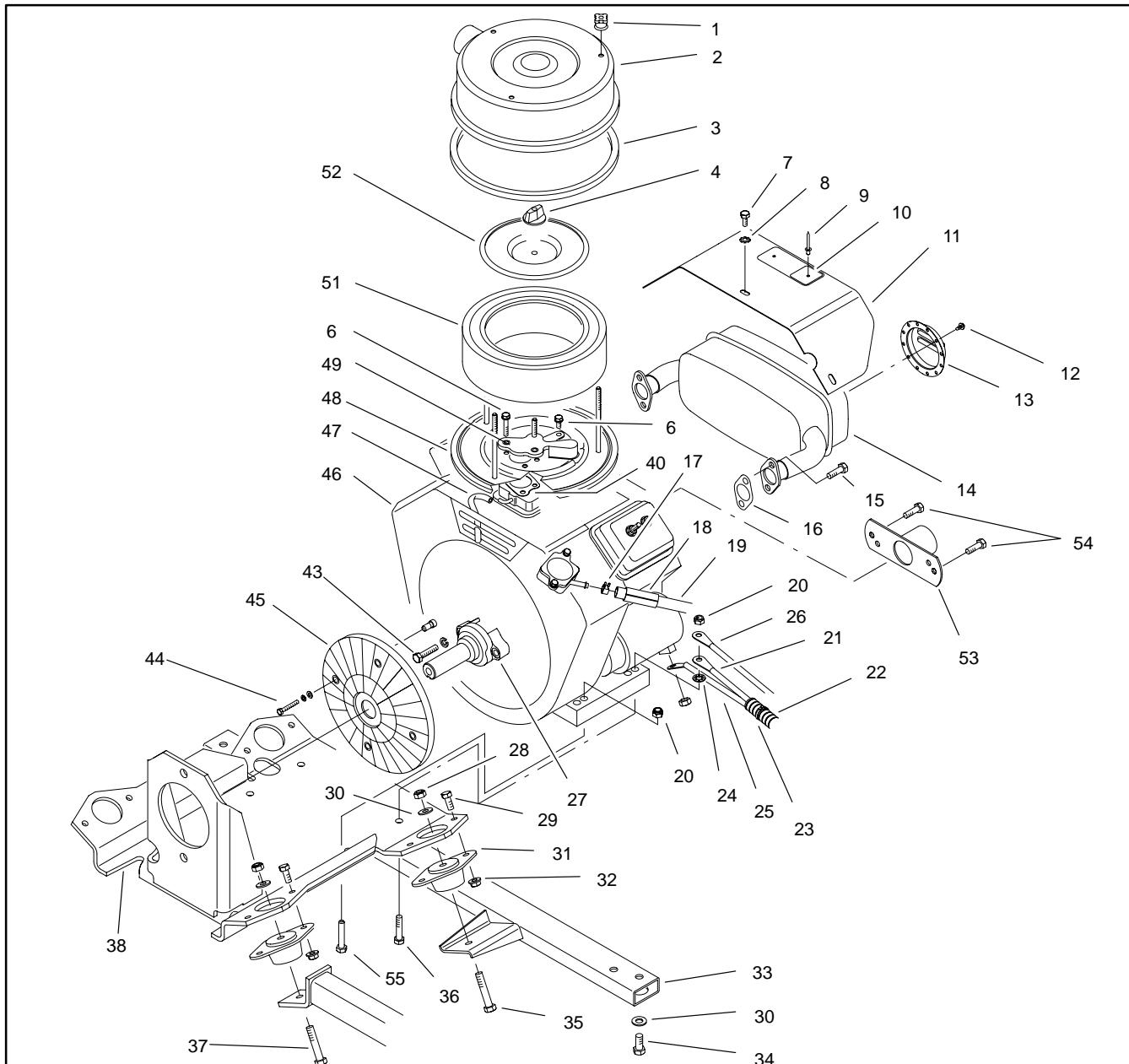


Figure 43

- | | | |
|--------------------------|---|-----------------------------|
| 1. Air cleaner knob | 20. Lock nut | 38. Engine base |
| 2. Air cleaner cover | 21. Battery cable (negative) | 39. Not used |
| 3. Cover seal | 22. Cable cover | 40. Carburetor gasket |
| 4. Air cleaner knob | 23. Cable tie | 41. Not used |
| 5. Not used | 24. Lock washer | 42. Not used |
| 6. Hex flange head screw | 25. Positive cable (from starter solenoid)) | 43. Cap screw |
| 7. Cap screw | 26. Ground wire (to frame) | 44. Cap screw |
| 8. Lock washer | 27. Stub shaft | 45. Screen/spacer |
| 9. Pop rivet | 28. Lock nut | 46. Engine |
| 10. Hot surface plate | 29. Cap screw | 47. Fuel hose |
| 11. Muffler shield | 30. Flat washer | 48. Air cleaner base |
| 12. Screw | 31. Engine mount | 49. Carburetor inlet shield |
| 13. Exhaust deflector | 32. Lock nut | 50. Not used |
| 14. Muffler | 33. Engine support | 51. Filter element |
| 15. Screw | 34. Cap screw | 52. Cover plate |
| 16. Exhaust gasket | 35. Cap screw | 53. Cover |
| 17. Hose clamp | 36. Cap screw | 54. Cap screw |
| 18. Rubber guard | 37. Cap screw | 55. Cap screw |
| 19. Fuel hose | | |

Engine Removal (Fig. 43)

1. Park machine on a level surface, lower attachment, stop engine, engage, and remove key from the ignition switch.
2. Chock wheels to prevent the machine from moving. The brake assembly will be partially disassembled.



CAUTION

The muffler and exhaust pipe may be hot. To avoid possible burns, allow engine and exhaust system to cool before working near muffler.

3. Remove attachment from the rear of the machine to gain access to the engine.
4. Pivot seat up. Remove seat base with seat attached as follows (Fig. 44):
 - A. Separate seat rod from the base by removing cotter pin and flat washer.
 - B. Separate base from frame by removing both lock nuts, cap screws, flat washers, and spacers.
5. Disconnect and remove battery from the machine to prevent the possibility of the engine damaging it during removal (see Battery Service in Chapter 5 – Electrical Systems).
6. Close fuel shutoff valve. Clamp fuel hose near engine to prevent fuel spillage. Loosen hose clamp at fuel pump and remove fuel hose from the pump.

7. Disconnect wire harness as follows (Fig. 45):
 - A. Disconnect blue wire from magneto terminal.
 - B. Disconnect blue wire with fusible link from voltage regulator.
 - C. Disconnect red/white wire from fuel solenoid.

IMPORTANT: Keep air cleaner base removed from the carburetor after disconnecting the choke cable from the choke lever. This is necessary to remove the engine from the machine.

8. Disconnect throttle control cable from the swivel and choke control cable from the choke lever (see Throttle and Choke Control Removal).
9. Loosen both set screws on the engine hub to remove hub from the engine shaft (Fig. 46).

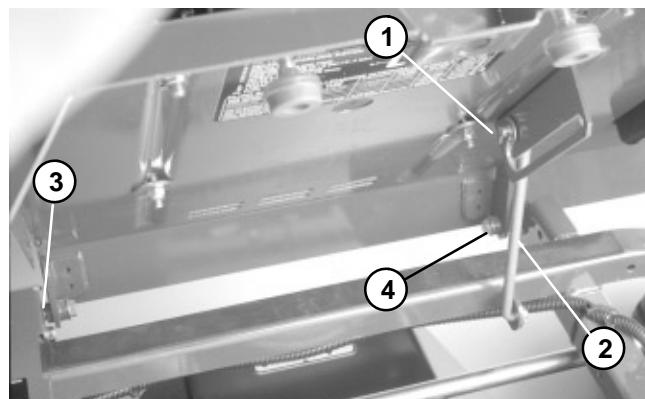


Figure 44

1. Cotter pin & flat washer 3. Lock nut
2. Seat rod 4. Cap screw & flat washer

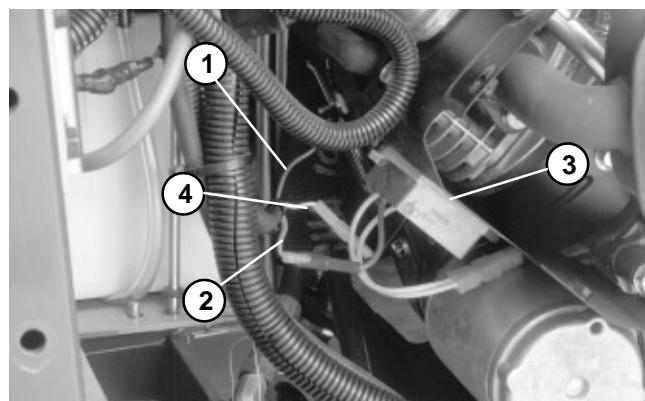


Figure 45

1. Blue wire (magneto) 3. Voltage regulator
2. Blue wire (voltage reg.) 4. Red/white wire

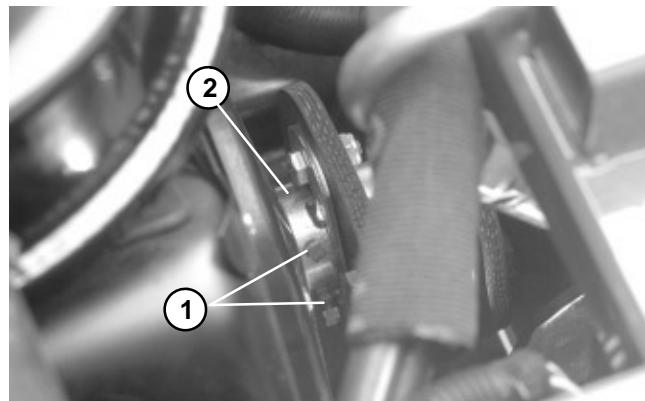


Figure 46

1. Set screw 2. Engine hub

10. Disconnect red positive cable cable (solenoid) from the starter (Fig. 47).

11. Remove lock nut and cap screw securing black ground wire and black battery cable (negative) to the engine block. Pull cable and harness clear of the engine (Fig. 47).

12. Remove remaining three lock nuts and cap screws securing the engine to its base.



CAUTION

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

One person should operate the jack while the other person guides the engine from the frame and engine base.

IMPORTANT: Make sure not to damage wires, wire harness, hoses, and cables while removing the engine from the machine.

13. Remove engine as follows (Fig. 43 and 48):

- Position a jack under the rear of the engine base.
- Support engine with a jack, then remove cap screws and flat washers securing the engine support to the frame.

IMPORTANT: When the rear of the engine base is lowered, the base will pivot at the front engine mounts. Lower base about 1 inch (2.5 cm), which is enough to allow the top of the engine to clear the traverse rod. Avoid damaging the cooling fan and oil cooler as the hydrostat pivots up. The engine should then slide off the base. Do not allow engine to drop.

- Lower rear of the engine base. Remove engine from the engine hub and base. Remove square key from the engine shaft.

14. Secure engine base and hydrostat to prevent the cooling fan from damaging the oil cooler.

Engine Installation (Fig. 43)



CAUTION

One person should operate the jack while the other person guides the engine into the frame.

IMPORTANT: Make sure not to damage the engine, fuel and hydraulic lines, electrical harness, or other parts while installing the engine.

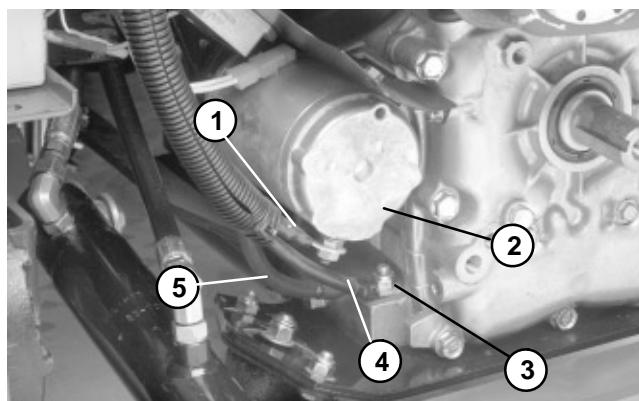


Figure 47

- Positive cable (solenoid)
- Starter
- Lock nut and cap screw
- Battery cable (negative)
- Ground wire (frame)

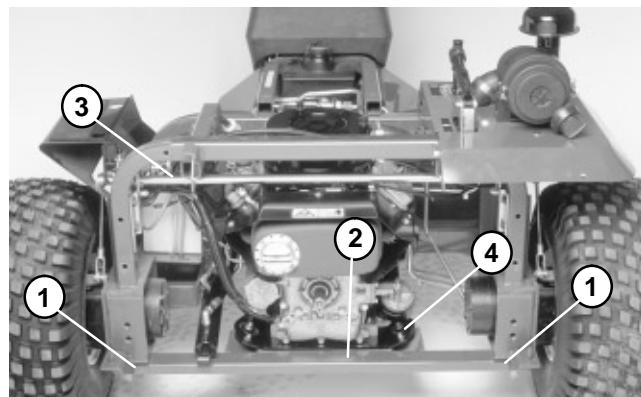


Figure 48

- Cap screw & flat washer
- Engine support
- Traverse rod
- Engine base

1. Install engine to its base as follows (Fig. 43 and 48):

- Attach a jack to the rear of the engine base.
- Make sure square key is placed on the shaft. Position engine onto the engine base. Slide engine shaft into the engine hub
- Insert three cap screws through engine base and engine block. Install lock nuts to the cap screws. Do not tighten fasteners at this time.
- Insert cap screw through engine base and engine block. Connect black ground wire and black battery cable (negative) to the cap screw. Screw lock nut onto the cap screw (Fig. 47).
- Tighten all four fasteners securing the engine to its base.
- Jack up engine base enough to secure the engine support to the frame. Secure engine support to the frame cap screws and flat washer.

2. Connect red positive cable cable (solenoid) to the starter (Fig. 47).

3. Tighten both set screws on the engine hub to secure hub to the engine shaft (Fig. 46).
4. Connect throttle control cable to the swivel and choke control cable to the choke lever (see Throttle and Choke Control Installation).
5. Connect wire harness as follows (Fig. 45):
 - A. Connect blue wire to the magneto terminal.
 - B. Connect blue wire with fusible link to voltage regulator.
 - C. Connect red/white wire to fuel solenoid.
6. Install seat base with seat attached to the frame as follows (Fig. 44):
 - A. Position base on machine. Secure base to frame with both spacers, cap screws, flat washers, and lock nuts.
 - B. Secure seat rod to the base with flat washer and cotter pin.
7. Install and connect battery to the machine (see Battery Service in Chapter 5 – Electrical Systems).
8. Secure fuel hose to the fuel pump with hose clamp. Remove clamp from fuel hose that was used to prevent fuel spillage. Open fuel shutoff valve.

Clean Cylinder Head Fins

Avoid overheating and possible damage to the engine.
Keep cooling fins on cylinder heads clean.

1. Park machine on a level surface, lower attachment, stop engine, engage parking brake, and remove key from the ignition switch.

2. Gain access to the engine.

NOTE: The engines on the SP 2020/3020 and SP 5020 are constructed the same. The SP 2020/3020 engine is shown.

3. Remove muffler shield and both air guide covers to gain access to both cylinder heads.



CAUTION

Use eye protection such as goggles when using compressed air.

4. Blow dirt and debris from between the cooling fins and away from the engine.
5. Use nylon bristle brush and hot soapy water to remove any encrusted mud or other debris on and between the cooling fins. Rinse fins with clear water after cleaning.
6. Secure both air guide covers and muffler shield to the engine.
7. Install engine cover to the machine.

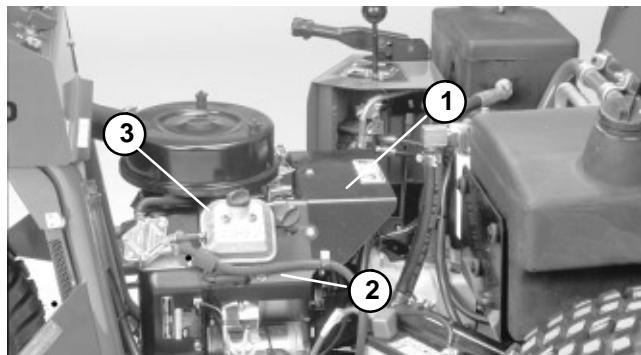


Figure 49

1. Muffler shield
2. Air guide cover (LH)
3. Cylinder head (LH)

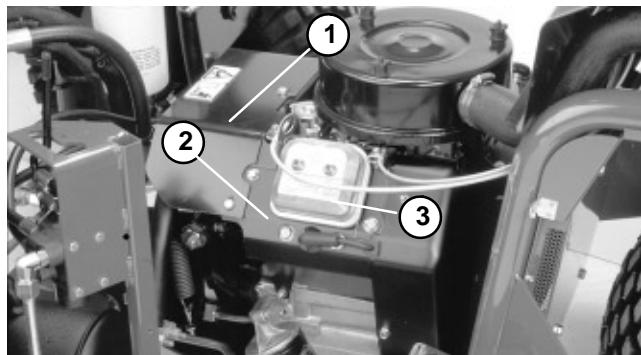


Figure 50

1. Muffler shield
2. Air guide cover (RH)
3. Cylinder head (RH)



Hydraulic Systems

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Specifications

Item	Description
Hydrostatic Transmission	Variable displacement piston pump
Pump Displacement	0.913 in ³ /rev (15.0 cm ³ /rev)
Pump Flow Rate (@ 3150 RPM)	12.5 GPM (47.2 LPM)
Maximum Continuous Rated Speed	4000 RPM
Maximum Intermittent Rated Speed	4200 RPM
Maximum Operating Pressure	2500 PSI (175 bar)
Maximum Intermittent Pressure	4500 PSI (310 bar)
Charge Pump Displacement	0.33 in ³ /rev (5.4 cm ³ /rev)
Charge Pump Flow Rate (@ 3150 RPM)	4.5 GPM (17.0 LPM)
Charge Relief Setting	90 to 180 PSI (4.8 to 10.4 bar)
Maximum Inlet Vacuum	5 inch Hg
Maximum Continuous Case Pressure	10 PSI (0.7 bar)
Maximum (Cold Start) Case Pressure	25 PSI (1.7 bar)
Implement Relief Setting	700 to 800 PSI (48.3 to 55.2 bar)
Right Wheel Motors (SP 2020/SP 3020)	Orbital rotor vane with shuttle valve
Motor Displacement	7.8 in ³ /rev (127.8 cm ³ /rev)
Maximum Operating Pressure	2000 PSI (138 bar)
Maximum Intermittent Pressure	3000 PSI (207 bar)
Maximum Flow	20 GPM (76 LPM)
Rated Speed @ Maximum Flow	583 RPM
Right Wheel Motors (SP 5020)	Orbital rotor vane with reverse timed manifold and shuttle valve
Motor Displacement	8.6 in ³ /rev (140.1 cm ³ /rev)
Maximum Operating Pressure	2000 PSI (138 bar)
Maximum Intermittent Pressure	3000 PSI (207 bar)
Maximum Flow	20 GPM (76 LPM)
Rated Speed @ Maximum Flow	530 RPM
Left Wheel Motors (SP 2020/SP 3020)	Orbital rotor vane
Motor Displacement	7.8 in ³ /rev (127.8 cm ³ /rev)
Maximum Operating Pressure	2000 PSI (138 bar)
Maximum Intermittent Pressure	3000 PSI (207 bar)
Maximum Flow	20 GPM (76 LPM)
Rated Speed @ Maximum Operating Pressure and Rated Flow	583 RPM
Left Wheel Motors (SP 5020)	Orbital rotor vane
Motor Displacement	8.6 in ³ /rev (140.9 cm ³ /rev)
Maximum Operating Pressure	2000 PSI (138 bar)
Maximum Intermittent Pressure	3000 PSI (207 bar)
Maximum Flow	20 GPM (76 LPM)
Rated Speed @ Maximum Flow	530 RPM
Front Wheel Motor (SP 3020)	Orbital rotor motor
Motor Displacement	5.0 in ³ /rev (81.9 cm ³ /rev)
Maximum Operating Pressure	3000 PSI (207 bar)
Maximum Intermittent Pressure	4000 PSI (276 bar)
Maximum Flow	12 GPM (45 LPM)
Rated Speed @ Maximum Flow	693 RPM
Front Wheel Motor (SP 5020)	Orbital rotor vane with reverse timed manifold
Motor Displacement	17.1 in ³ /rev (280.3 cm ³ /rev)
Maximum Operating Pressure	2000 PSI (138 bar)
Maximum Intermittent Pressure	3000 PSI (207 bar)
Maximum Flow	25 GPM (95 LPM)
Rated Speed @ Maximum Flow	334 RPM
Hydraulic Filter	25 Micron spin on cartridge type
Hydraulic Oil	See Check Hydraulic System Fluid in General section
Hydraulic Tank	Tank capacity 3.0 gal. U.S. (20.8 L)

General Information

Hydraulic Hoses

Hydraulic hoses are subject to extreme conditions such as pressure differentials during operation and exposure to weather, sun, chemicals, very warm storage conditions, or mishandling during operation or maintenance. These conditions can cause damage or premature deterioration. Some hoses are more susceptible to these conditions than others. Inspect the hoses frequently for signs of deterioration or damage.

When replacing a hydraulic hose, be sure that the hose is straight (not twisted) before tightening the fittings. This can be done by observing the imprint on the hose. Use two wrenches; hold the hose straight with one and tighten the hose swivel nut onto the fitting with the other.



WARNING

Before disconnecting or performing any work on hydraulic system, relieve all pressure in system. Stop engine; lower or support box and/or other attachment(s).

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

Hydraulic Fitting Installation

O-Ring Face Seal

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.
2. Make sure the O-ring is installed and properly seated in the groove. It is recommended that the O-ring be replaced any time the connection is opened.
3. Lubricate the O-ring with a light coating of oil.
4. Put the tube and nut squarely into position on the face seal end of the fitting and tighten the nut until finger tight.
5. Mark the nut and fitting body. Hold the body with a wrench. Use another wrench to tighten the nut to the correct flats from finger tight (F.F.T.). The markings on the nut and fitting body will verify that the connection has been tightened.

Size	F.F.T.
4 (1/4 in. nominal hose or tubing)	0.75 ± 0.25
6 (3/8 in.)	0.75 ± 0.25
8 (1/2 in.)	0.75 ± 0.25
10 (5/8 in.)	1.00 ± 0.25
12 (3/4 in.)	0.75 ± 0.25
16 (1 in.)	0.75 ± 0.25

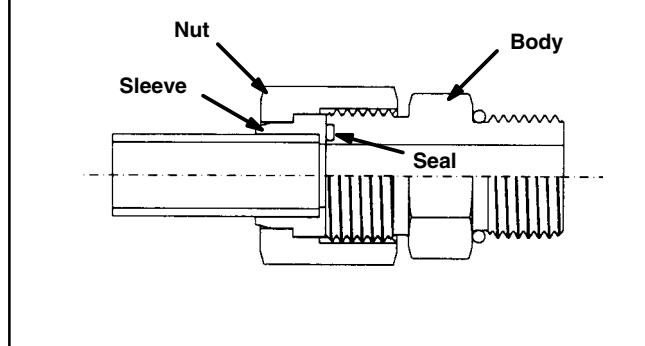


Figure 1

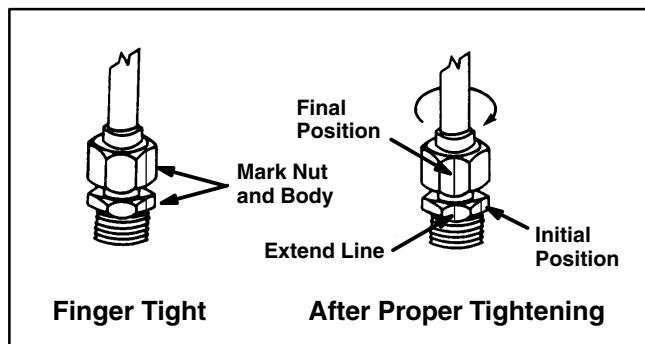


Figure 2

SAE Straight Thread O-Ring Port – Non-adjustable

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.
2. Always replace the O-ring seal when this type of fitting shows signs of leakage.
3. Lubricate the O-ring with a light coating of oil.
4. Install the fitting into the port and tighten it down full length until finger tight.
5. Tighten the fitting to the correct flats from finger tight (F.F.F.T.).

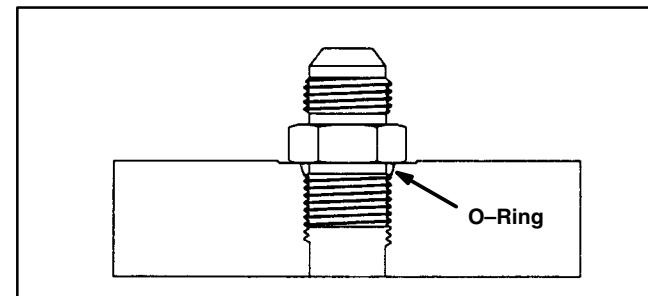


Figure 3

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

SAE Straight Thread O-Ring Port – Adjustable

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.
2. Always replace the O-ring seal when this type of fitting shows signs of leakage.
3. Lubricate the O-ring with a light coating of oil.
4. Turn back the jam nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1).
5. Install the fitting into the port and tighten finger tight until the washer contacts the face of the port (Step 2).
6. To put the fitting in the desired position, unscrew it by the required amount, but no more than one full turn (Step 3).
7. Hold the fitting in the desired position with a wrench and turn the jam nut with another wrench to the correct flats from finger tight (F.F.F.T.) (Step 4).

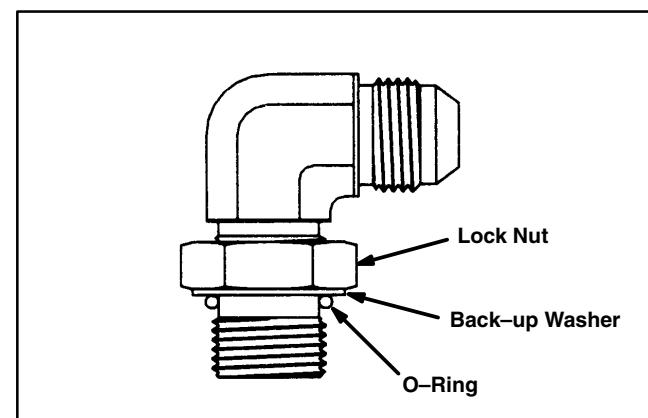


Figure 4

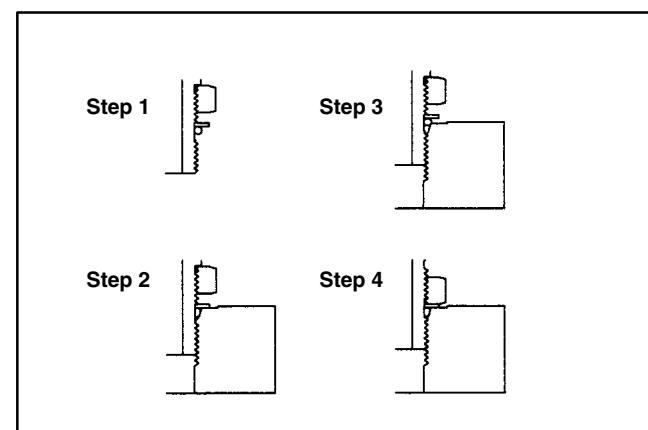


Figure 5

Towing Traction Unit

In case of emergency, the Sand Pro can be towed for a short distance. However, Toro does not recommend this as a standard procedure.

IMPORTANT: Do not tow the machine faster than 2 to 3 mph because drive system may be damaged. If machine must be moved a considerable distance, transport it on a truck or trailer. Tires may lock up if machine is towed too fast. If lock up occurs, stop towing the machine. Wait for the traction circuit pressure to stabilize before resuming towing at a slower speed.

Check Hydraulic System Fluid

The hydraulic system is designed to operate on Mobil 424 hydraulic oil. The machine's 3 gallon tank is filled at the factory with oil. However, check oil level before the engine is first started and daily thereafter.

1. Remove cap from the hydraulic oil tank.
2. Check oil level in the tank. Oil level should be up to the top of the cone point on tank screen.

IMPORTANT: To prevent system contamination, clean top of hydraulic oil containers before puncturing. Assure pour spout and funnel are clean.

3. If fluid level is low, slowly fill tank with appropriate hydraulic fluid until level reaches bottom of screen. **DO NOT OVERFILL.**

NOTE: The fluids within this group are interchangeable.

Group 1 Hydraulic Fluid (Recommended for ambient temperatures consistently below 100° F.):

ISO type 46/68 anti-wear hydraulic fluid

Mobil	Mobil Fluid 424
Amoco	Amoco 1000
International Harvester	Hy-Tran
Texaco	TDH
Shell	Donax TD
Union Oll	Hydraulic/Tractor Fluid
Chevron	Tractor Hydraulic Fluid
BP Oil	BP HYD TF
Boron Oll	Eldoran UTH
Exxon	Torque Fluid
Conoco	Power-Tran 3
Kendall	Hyken 052
Phillips	HG Fluid

4. Install tank cap.

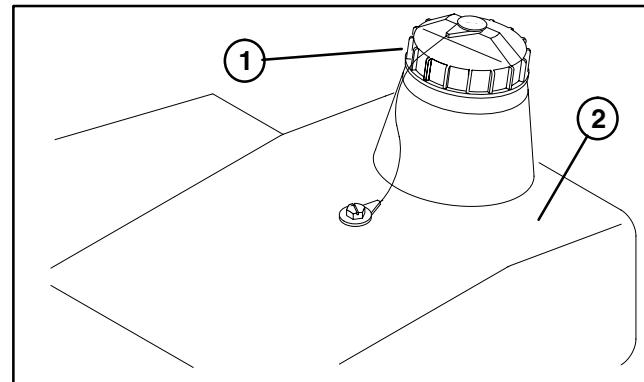


Figure 6

1. Cap
2. Tank (SP 2020/3020)

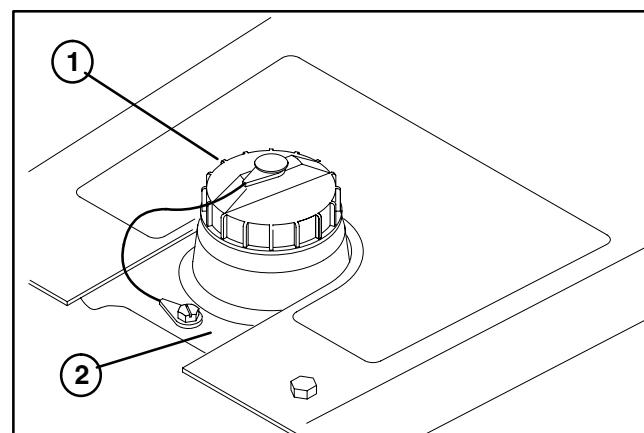
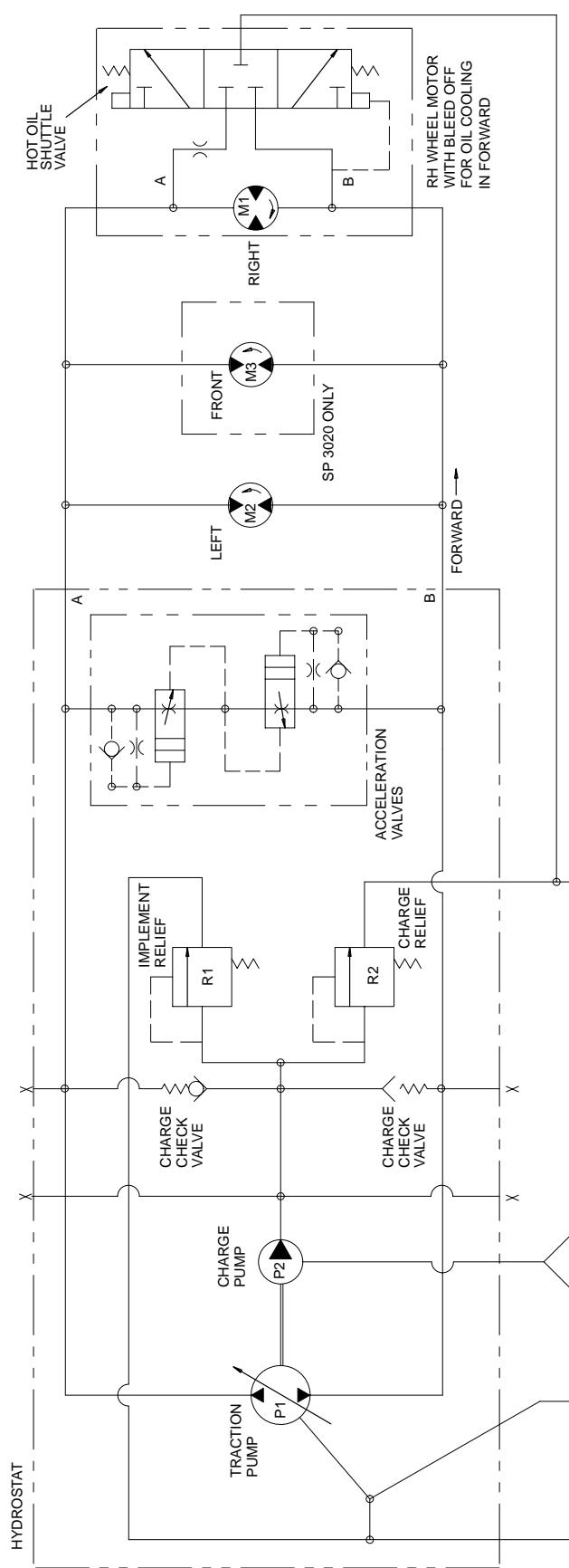


Figure 7

1. Cap
2. Tank (SP 5020)

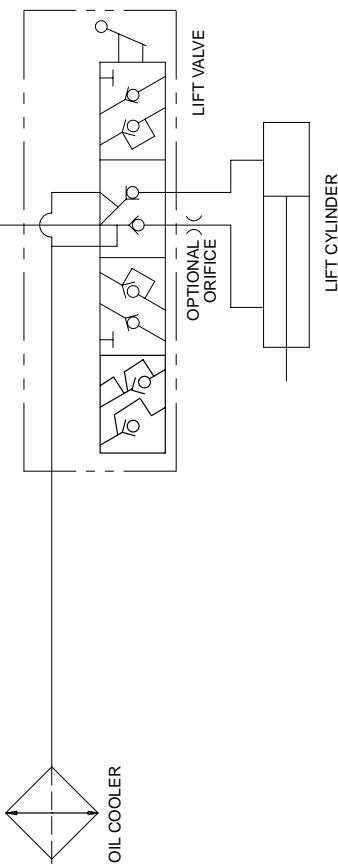
Hydraulic Schematics

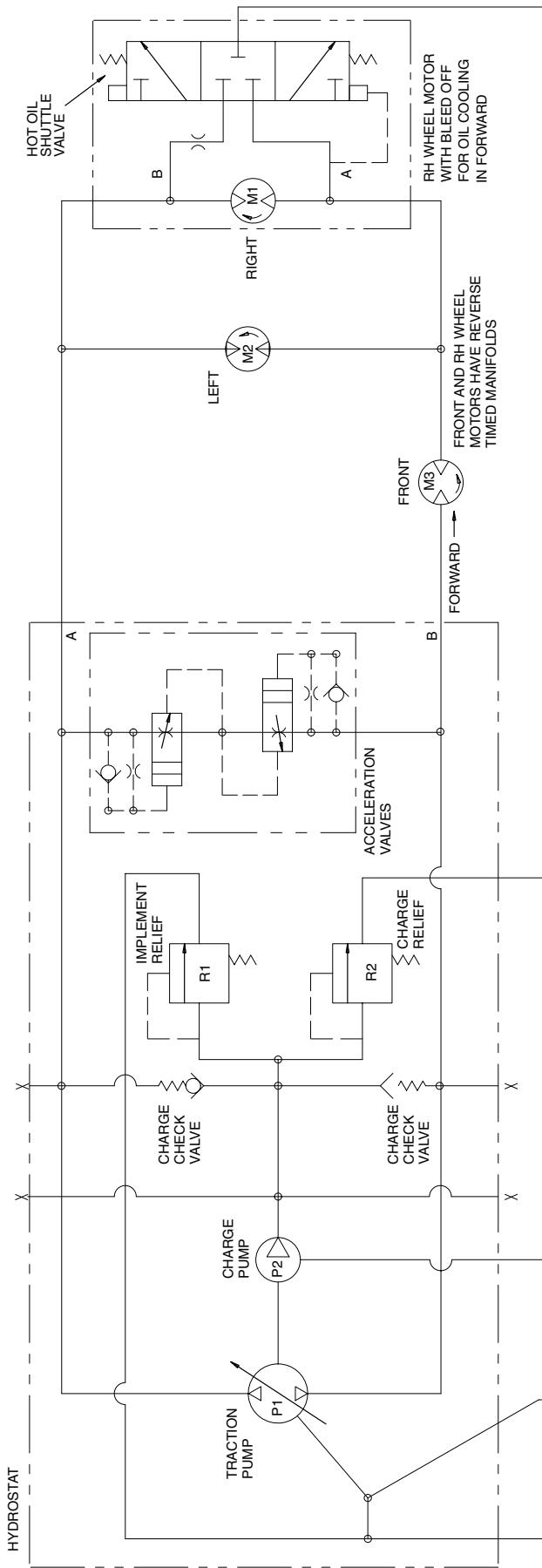


COMPONENT	DISPLACEMENT		PRESSURE		* FLOW RATE	
	in ³ /rev	cm ³ /rev	lbs/in ²	bars	GPM	LPM
P1	0.915	15	—	—	12.48	47.2
P2	0.33	5.41	—	—	4.5	17
M1	7.8	127.84	—	—	—	—
M2	7.8	127.84	—	—	—	—
M3	5.0	81.97	—	—	—	—
R1	—	—	700	48.3	—	—
R2	—	—	90	6.2	—	—

* FLOW RATE CALCULATED AT 3150 RPM

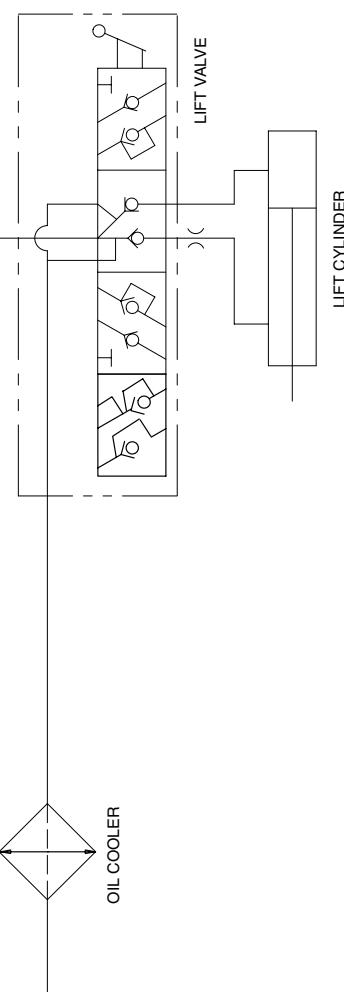
Sand Pro 2020/3020
Hydraulic Schematic





COMPONENT	DISPLACEMENT		PRESSURE		* FLOW RATE LPM
	in 3/rev	cm 3/rev	lbs/in 2	bars	
P1	0.915	15	—	—	12.48
P2	0.33	5.41	—	—	4.5
M1	8.6	140.93	—	—	17
M2	8.6	140.93	—	—	—
M3	17.1	280.22	—	—	—
R1	—	—	700	48.3	—
R2	—	—	90	6.2	—

* FLOW RATE CALCULATED AT 3150 RPM



Sand Pro 5020
Hydraulic Schematic

Hydraulic Flow Diagrams

Traction Forward

The traction circuit of the hydraulic system consists of a hydrostat connected in a closed loop circuit to three orbital vane wheel motors. Hydraulic fluid losses are designed to occur from case drain leakage of the traction pump (P1) and bleed off from the right wheel motor (M1). These losses are replenished by the charge pump (P2), which is integral to the hydrostat.

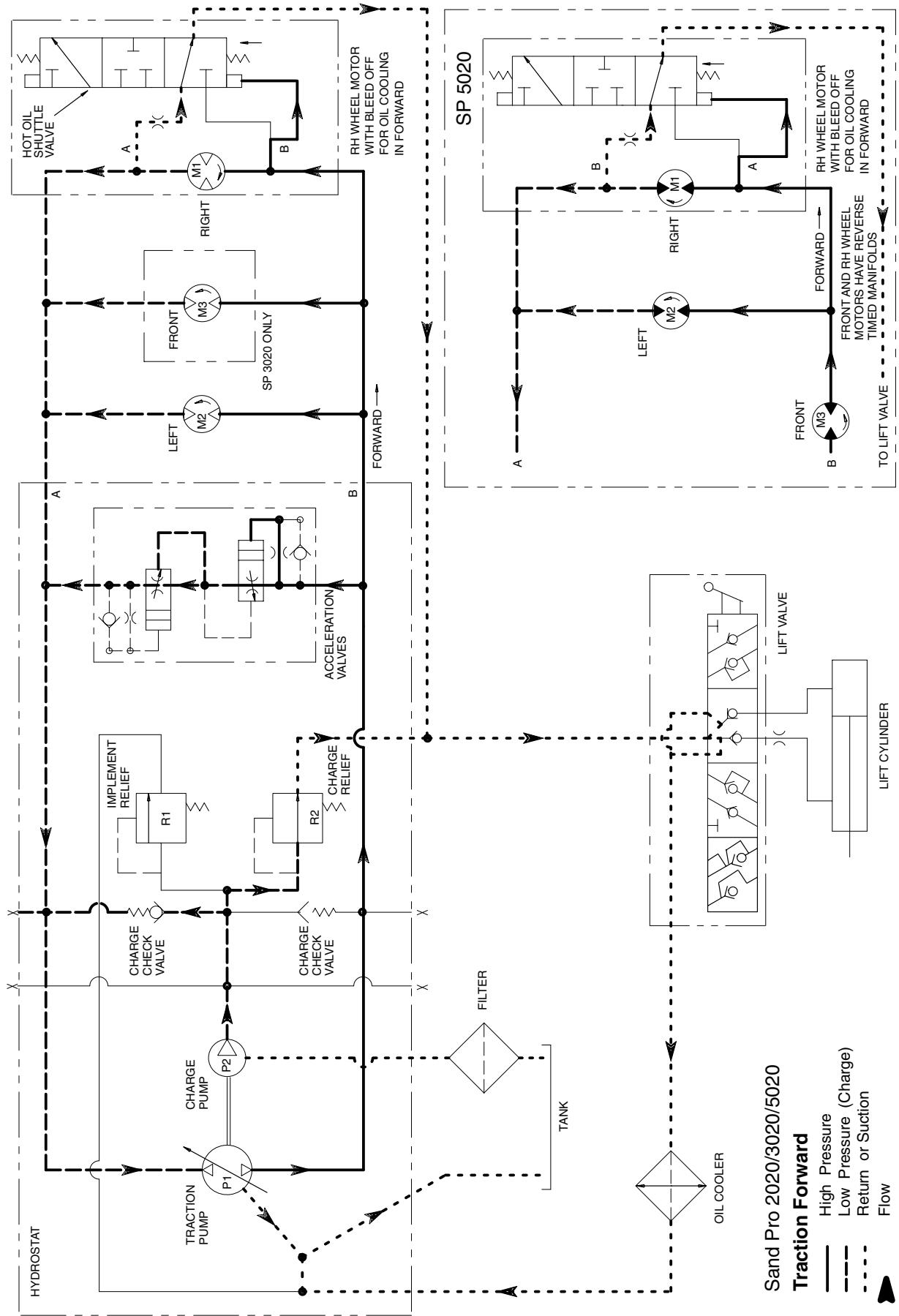
The engine drives traction pump (P1) directly through a coupling. The traction pump is a variable displacement piston pump. The traction pedal connects through a linkage to the trunnion shaft and swash plate of the pump. With the engine running and the traction pedal in the neutral position, P2 supplies no flow to the wheel motors. When the traction pedal is pressed to the forward position, the linkage from the pedal positions the swash plate in the traction pump so oil flows out port B. Oil flow out of port B goes to the wheel motors and turns them in the forward direction. On the SP 5020, the oil flow goes through the front motor first and then through the left and right rear wheel motors. Oil flowing out of the wheel motors returns to port A of the hydrostat and is continuously pumped out of port B.

The hydrostat uses a small amount of hydraulic fluid for internal lubrication. Fluid is designed to leak across pump parts into the case drain. This leakage results in the loss of hydraulic fluid from the closed loop circuit that must be replenished.

The charge pump (P2) is a fixed displacement gerotor pump. It is driven directly off the traction pump. The pump replenishes the closed loop circuit with fluid from the tank. The charge relief valve (R2) supplies sufficient head so that charge pump flow is guided to the low pressure side of the traction circuit through one of two check valves. Pump flow in excess of replenishment requirements is relieved through the charge relief valve back to the tank.

The right wheel motor bleeds off a small amount of hydraulic fluid for cooling of the closed loop circuit. This bleed off happens in the forward direction only. The high pressure side of the motor forces a shuttle spool to shift against a spring. The pressure drop across the motor causes a small amount of fluid to bleed off through a fixed orifice on the low pressure side of the motor and then through the shuttle spool. This bleed off returns to the tank through the oil cooler.

The acceleration valves reduce the rate of change in acceleration (jerkiness) when hydrostat output is increased by the action of the operator. An increase of pressure on the output side of the hydrostat will by-pass some pump flow to the low pressure side of the pump. The valve on the high pressure side closes at a predetermined rate as pressure increases. This gives the hydrostat a smooth acceleration rate when the swashplate is stroked rapidly.



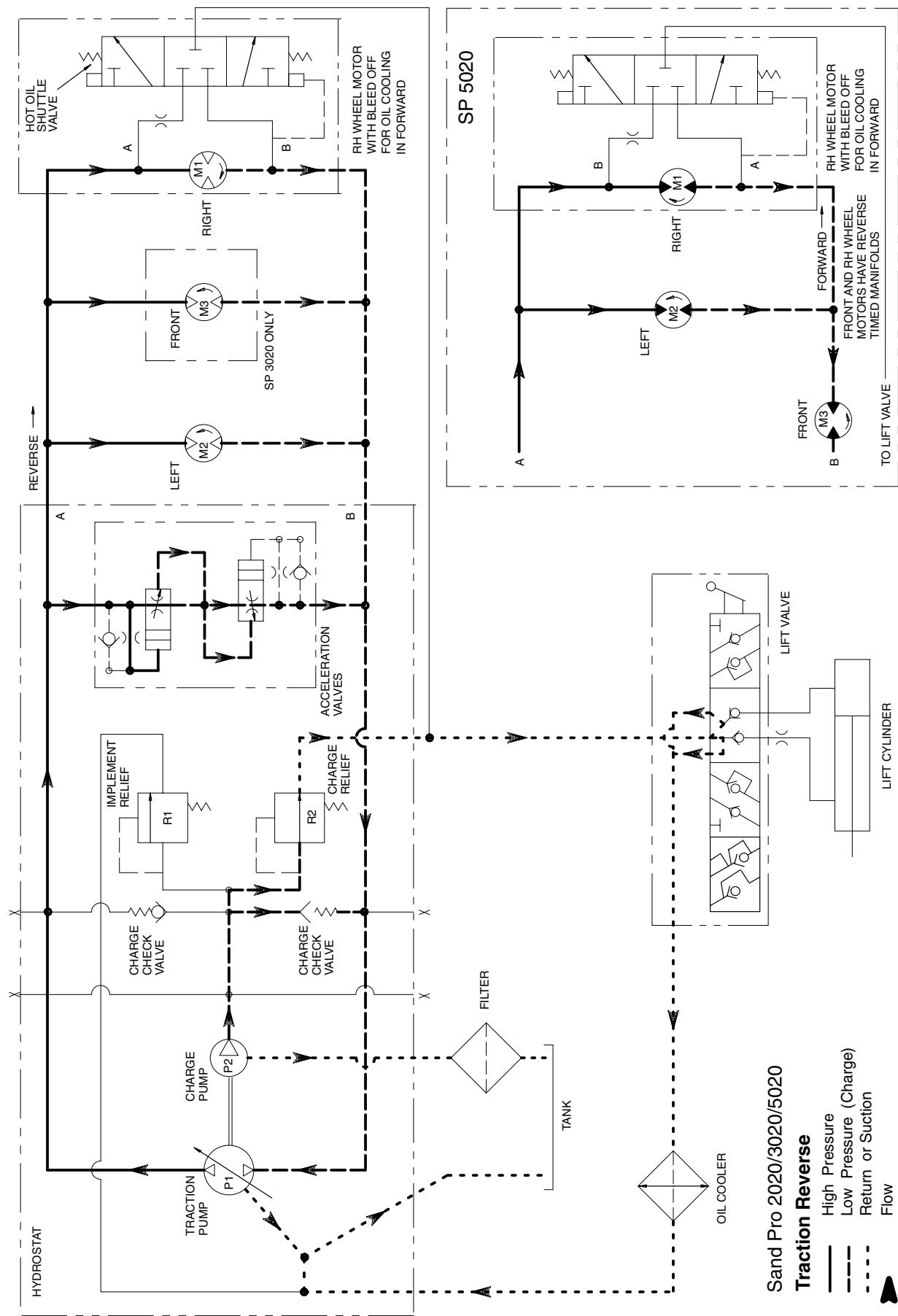
Traction Reverse

The traction circuit operates essentially the same in reverse as it does in forward. However, there are a few differences in operation.

When the traction pedal is pressed to the reverse position, the linkage from the pedal positions the swash plate in the traction pump so oil flows out of port A. Oil flow out of port A goes to the wheel motors and turns them in the reverse direction. On the **SP 5020**, the oil flow goes through the left and right rear wheel motors first and then through the front wheel motor. Oil flowing out of the wheel motors returns to port B of the hydrostat and is continuously pumped out of port A.

The right wheel motor **does not** bleed off any hydraulic fluid for cooling of the closed loop circuit in the reverse direction.

Hydraulic Systems



Retract and Extend Lift Cylinder

The hydraulic lift circuits for the **SP 2020/3020** and **SP 5020** function identically. Each machine has identical charge pumps, lift valves, and lift cylinders. These components are the heart of the lift circuit.

In addition to replenishing the closed loop circuit with fluid from the tank, charge pump (P2) flow in excess of replenishment requirements is relieved through the charge relief valve (R2). Fluid returns through the lift valve and back to the tank. This excess flow is used to operate the lift cylinder.

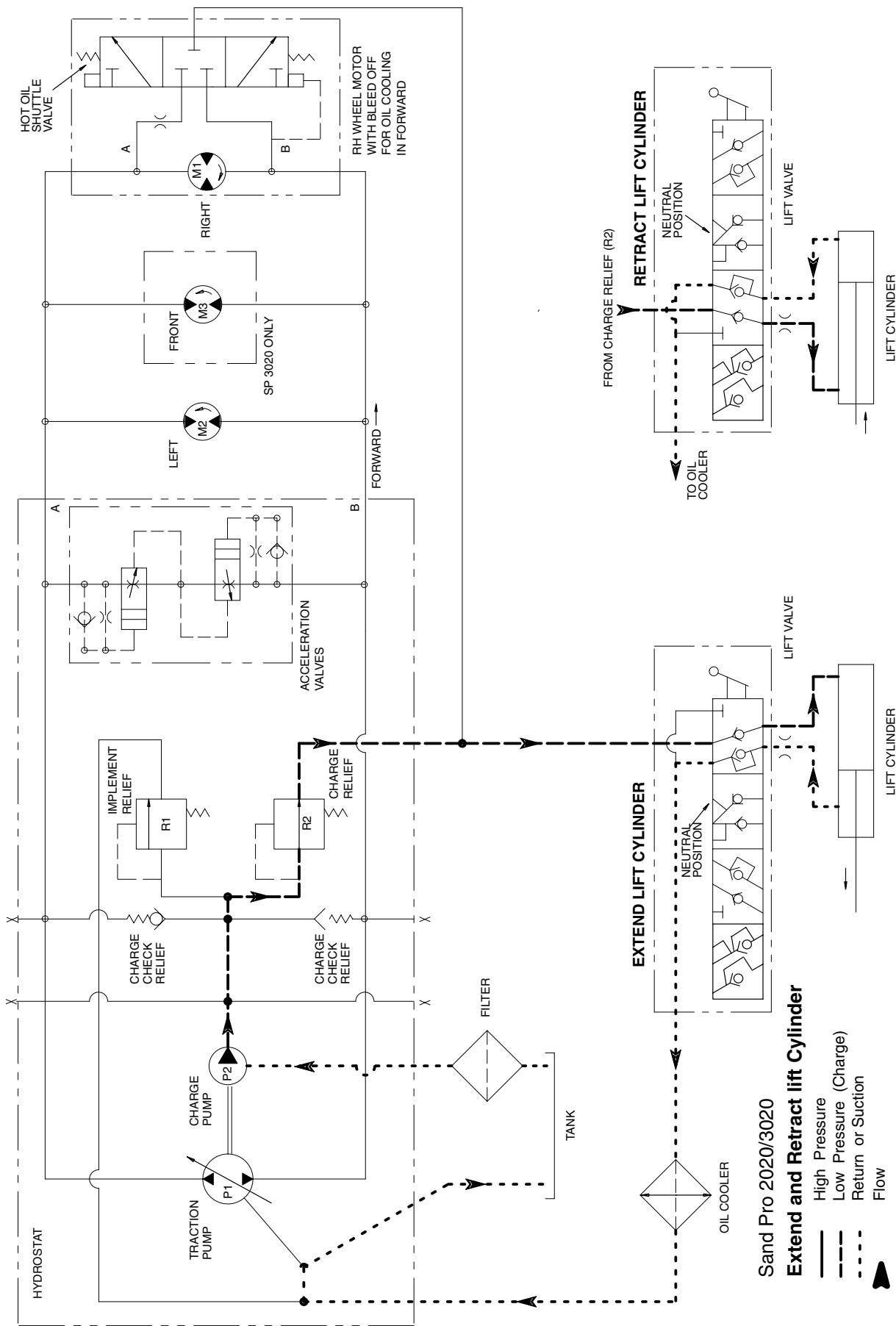
The charge pump is a fixed displacement gerotor pump that is driven directly off the traction pump (P1). It has sufficient output to handle intermittent operation of the lift cylinder under load. The implement relief valve (R1) in the charge circuit allows high enough pressure to operate the lift cylinder with attachments, and protects the charge pump.

When the lift lever to the lift valve is in the neutral position, fluid flow from the charge pump is bypassed around the lift cylinder through the lift valve. Fluid returns to the tank as a normal part of the charge and bleed off circuits.

Moving the lift lever to the lift position allows the lift valve to direct fluid flow from the charge pump into the rod side of the piston. The piston moves into the cylinder pushing fluid out the piston end of the cylinder and to the tank. As the cylinder rod retracts, the attachment is raised. When the lift lever is released, the lift valve returns to the neutral position. The attachment is held in its present position.

Moving the lift lever to the lower position allows the lift valve to direct fluid flow from the charge pump into the piston side of the cylinder. The piston moves out of the cylinder pushing fluid out the rod end of the cylinder and to the tank. As the cylinder rod extends, the attachment is lowered. When the lift lever is released, the lift valve returns to the neutral position. The attachment is held in its present position.

Excessive load on the lift cylinder causes circuit pressure to increase and the implement relief valve (R1) to dump directly to the tank. This condition happens in both the lift and lower modes.



Special Tools

Order these tools from the *TORO SPECIAL TOOLS AND APPLICATIONS GUIDE (COMMERCIAL PRODUCTS)*.

Some tools may also be available from a local supplier.

Hydraulic Pressure Test Kit – TOR47009

Use to take various pressure readings for diagnostic tests. Quick disconnect fittings provided attach directly to mating fittings on machine test ports without tools. A high pressure hose is provided for remote readings. Contains one each: 1000 PSI (70 Bar), 5000 PSI (350 Bar) and 10000 PSI (700 Bar) gauges. Use gauges as recommended in Testing section of this chapter.



Figure 8

Hydraulic Tester (Pressure and Flow) – TOR214678

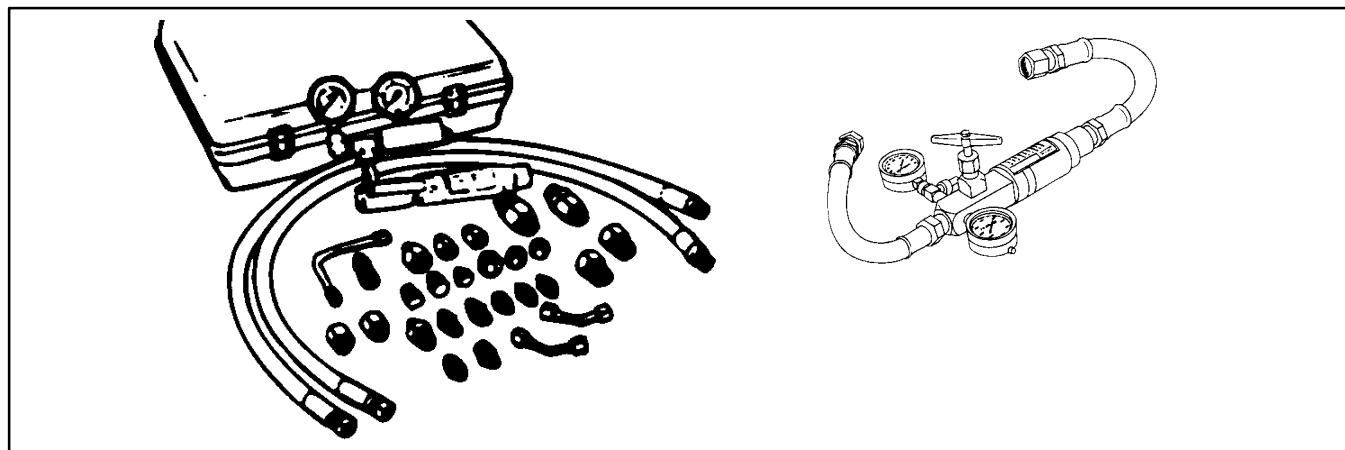


Figure 9

This tester requires O-ring face seal (ORFS) adapter fittings for use on this machine.

1. INLET HOSE: Hose connected from the system circuit to the inlet side of the hydraulic tester.
2. LOAD VALVE: A simulated working load is created in the circuit by turning the valve to restrict flow.
3. LOW PRESSURE GAUGE: Low range gauge to provide accurate reading at low pressure, 0 to 1000 PSI.

A protector valve cuts out when pressure is about to exceed the normal range for the gauge. The cutout pressure is adjustable.

4. HIGH PRESSURE GAUGE: High range gauge which accommodates pressures beyond the capacity of the low pressure gauge, 0 to 5,000 PSI.
5. FLOW METER: This meter measures actual oil flow in the operating circuit with a gauge rated at 15 GPM.
6. OUTLET HOSE: A hose from the outlet side of the hydraulic tester connects to the hydraulic system circuit.

Hydraulic Test Fitting Kit – TOR4079

This kit includes a variety of O-ring Face seal fittings to enable you to connect test gauges into the system.

The kit includes: tee's, unions, reducers, plugs, caps, and male test fittings.

TORO TEST FITTING KIT (NO. TOR4079)	
FITTING	TOOL NUMBER
Ballcock Nut Male Tee (3/8 in.)	Size: 3/8 in. Tool No.: T204079-01 Size: 1/2 in. Tool No.: T204079-12 Size: 1/4 in. Tool No.: T204079-13 Size: 1/8 in. Tool No.: T204079-14
Plug (3/8 in.)	Size: 3/8 in. Tool No.: T204079-02 Size: 1/2 in. Tool No.: T204079-15 Size: 1/4 in. Tool No.: T204079-16 Size: 1/8 in. Tool No.: T204079-17
Cap (3/8 in.)	Size: 3/8 in. Tool No.: T204079-03 Size: 1/2 in. Tool No.: T204079-18 Size: 1/4 in. Tool No.: T204079-19 Size: 1/8 in. Tool No.: T204079-20
FITTING	TOOL NUMBER
Union (3/8 in.)	Size: 3/8 in. Tool No.: T204079-04 Size: 1/2 in. Tool No.: T204079-21 Size: 1/4 in. Tool No.: T204079-22 Size: 1/8 in. Tool No.: T204079-23
Reducer (3/8 in.)	Size: 3/8 in. Tool No.: T204079-05 Size: 1/2 in. Tool No.: T204079-24 Size: 1/4 in. Tool No.: T204079-25 Size: 1/8 in. Tool No.: T204079-26
Tee Cap Fitting (3/8 in.)	Size: 3/8 in. Tool No.: T204079-06 Size: 1/2 in. Tool No.: T204079-27 Size: 1/4 in. Tool No.: T204079-28 Size: 1/8 in. Tool No.: T204079-29
Male Fitting (3/8 in.)	Size: 3/8 in. Tool No.: T204079-30 Size: 1/2 in. Tool No.: T204079-31 Size: 1/4 in. Tool No.: T204079-32 Size: 1/8 in. Tool No.: T204079-33

Figure 10

Hydraulic Test Fittings

On the **SP 2020/3020**, there is tight clearance between the charge pressure test port on the hydrostat and the engine base plate. It might be helpful to first attach a male pipe (swivel) adapter to the test port and then a street elbow before connecting a test gauge.

Both fittings carry the following Parker Hannifin part numbers:

Male Pipe Adapter 0107-2-2

Street Elbow 1/8 CD

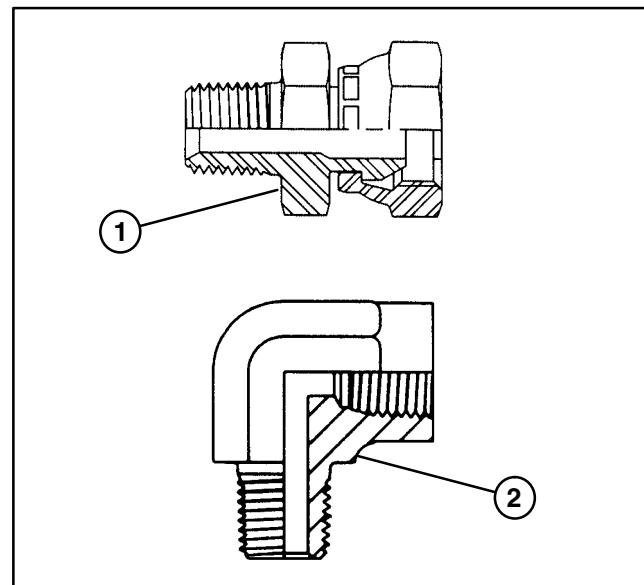


Figure 11
1. Swivel Adapter 2. Street elbow

Troubleshooting

The table that follows contains information to assist in troubleshooting. There may possibly be more than one cause for a machine malfunction.

Refer to the Testing section of this Chapter for precautions and specific test procedures.

Problem	Possible Cause
Hydraulic oil leaks from the system.	Fitting(s), hose(s), or tube(s) are loose or damaged. O-ring(s) or seal(s) are missing or damaged.
Hydraulic fluid foams.	Oil level in tank is low. Hydraulic system has wrong type of oil. One of the pump suction lines has an air leak.
Hydraulic system operates hot.	Oil level in tank is low. Oil is contaminated or too light. Heat exchanger is damaged or plugged. Accelerator valves leak from high pressure to low pressure side. Charge pressure is low due to the following possible causes: Oil filter is clogged. Charge relief valve is defective. Implement relief valve is defective. Charge pump is defective. Traction pump outlet pressure is high due to the following possible causes: Wheel load is to high or brakes are applied. Traction pump is worn or damaged. Shuttle valve in RH rear wheel motor is stuck or faulty. Wheel motor(s) are worn or damaged.
Unit operates in one direction only.	External control linkage is misadjusted, disconnected, binding, or damaged. Charge check valve in hydrostat is defective. Acceleration valves in hydrostat are defective.
Neutral is difficult to find.	External control linkage is misadjusted, disconnected, binding, or damaged.
Wheel motor will not turn.	Internal parts in wheel motor are damaged. Brakes are binding. Key on wheel motor shaft is sheared or missing.

Troubleshooting (cont.)

Problem	Possible Cause
System operates in a jerky manner when starting.	<p>External control linkage is misadjusted, disconnected, binding, or damaged.</p> <p>Charge valve in hydrostat is defective.</p> <p>Acceleration valves in hydrostat are defective.</p>
No traction exists in either direction, or loss of power.	<p>Brake is not released.</p> <p>Hydraulic oil is very cold.</p> <p>Oil level in tank is low.</p> <p>External control linkage is misadjusted, disconnected, binding, or damaged.</p> <p>Charge pressure is low due to the following possible causes:</p> <ul style="list-style-type: none"> Oil filter is clogged. Charge relief valve is defective. Implement relief valve is defective. Charge pump is defective. <p>Traction pump outlet pressure is low due to the following possible causes:</p> <ul style="list-style-type: none"> Accelerator valves are defective. Charge check valves are defective. Traction pump is worn or defective. <p>Wheel motor(s) are worn or damaged.</p>
Wheel motor will not hold load in neutral.	<p>Make up fluid from charge pump is not available.</p> <p>Charge check valves are damaged.</p>
Attachment will not lift or lifts slowly.	<p>Engine speed is too low.</p> <p>Charge pump is damaged.</p> <p>Lift cylinder linkage is binding or broken.</p> <p>Lift cylinder bushings bind.</p> <p>Tank oil level is low.</p> <p>Charge pump pressure or flow is insufficient.</p> <p>Implement relief valve is stuck open.</p> <p>Lift cylinders leak internally.</p>

Troubleshooting (cont.)

Problem	Possible Cause
Attachment raises, but will not stay up.	Lift cylinders leak internally. Neutral position check valves in lift valve leak.
Difficult to make slight changes when raising and lowering the attachment (Sand Pro 2020 and 3020).	Optional orifice fitting (85–9720) for lift control outlet is available that will improve sensitivity of lift control valve. This fitting is standard on the Sand Pro 5020.

Testing

The most effective method for isolating problems in the hydraulic system is by using hydraulic test equipment such as pressure gauges and flow meters in the circuits during various operational checks (See the Special Tools section in this Chapter).

Before Performing Hydraulic Tests

IMPORTANT: All obvious areas such as oil supply, filter, binding linkages, loose fasteners, or improper adjustments must be checked before assuming that a hydraulic component is the source of the problem.

Precautions for Hydraulic Testing



CAUTION

Failure to use gauges with recommended pressure (psi) rating as listed in test procedures could result in damage to the gauge and possible personal injury from leaking hot oil.

All testing should be performed by two (2) people. One person should be in the seat to operate the machine, and the other should read and record test results.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.



WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. Stop engine; Lower or support attachments.



WARNING

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Do not use hands to search for leaks; use paper or cardboard. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

1. Clean machine thoroughly before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. Contamination will cause excessive wear of components.
2. Put metal caps or plugs on any hydraulic lines left open or exposed during testing or removal of components.
3. The engine must be in good operating condition. Use a phototac when performing a hydraulic test. Engine speed can affect the accuracy of the tester readings.
4. The inlet and the outlet hoses must be properly connected and not reversed (tester with pressure and flow capabilities) to prevent damage to the hydraulic tester or components.
5. When using tester with pressure and flow capabilities, open load valve completely in the hydraulic tester to minimize the possibility of damaging components.
6. Install fittings finger tight and far enough to make sure that they are not cross-threaded before tightening them with a wrench.
7. Position tester hoses to prevent **rotating** machine parts from contacting and damaging the hoses or tester.
8. Check oil level in the tank. After connecting test equipment, make sure tank is full.
9. Check the traction pedal linkage for improper adjustment, binding or broken parts.
10. All hydraulic tests should be made with the hydraulic oil at normal operating temperature.

TEST NO. 1: Traction Pump Flow (P1)

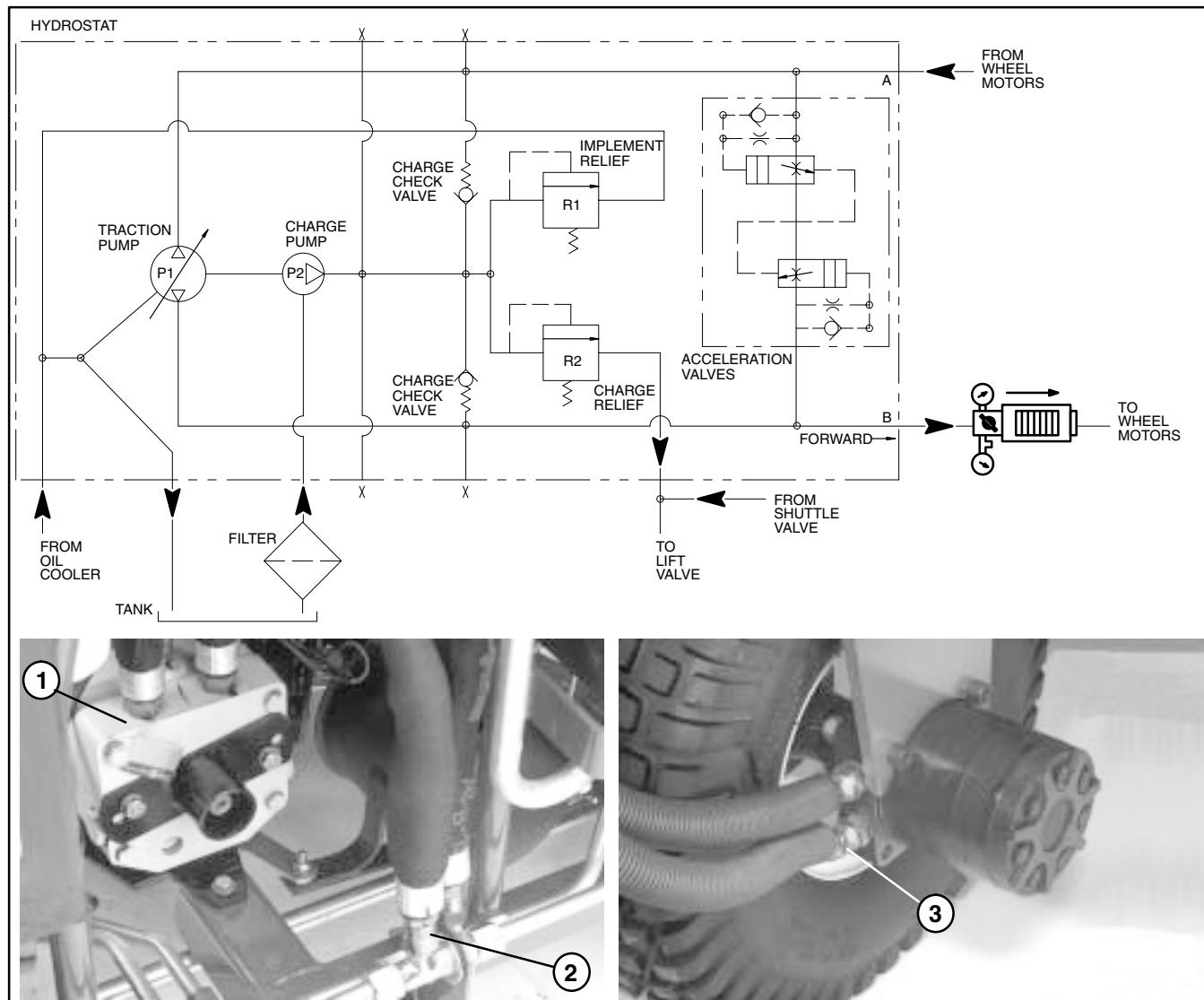


Figure 12

1. Hydrostat (SP 2020/3020)

2. Forward header (SP 2020/3020)

3. Wheel motor connector (SP 5020)

Procedure for Traction Pump Flow (P1) (Fig.12):

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Make sure machine is parked on a level surface with attachments removed. Make sure engine is off.
3. Read Precautions for Hydraulic Testing.
4. Make sure that traction pedal is adjusted to the neutral and forward positions (see Adjust Traction Pedal for Neutral and Forward).



WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

1. Jack up machine as follows to allow the drive wheels to spin freely and to allow hydraulic flow through the traction circuit:
 - A. On the **SP 2020**, jack up both rear wheels. Support machine with blocks or jack stands so that both rear wheels are off the ground.
 - B. On the **SP 3020** and **SP 5020**, jack up both rear wheels and the front wheel. Support machine with blocks or jack stands so that all three wheels are off the ground.
2. Disconnect hydraulic connections to install hydraulic tester (flow meter).
 - A. On the **SP 2020/3020**, disconnect left hose at the forward header.
 - B. On the **SP 5020**, disconnect bottom hose at the front wheel motor.
3. Install hydraulic tester (flow meter). **Make sure the flow control valve is fully open.**
 - A. On the **SP 2020/3020**, make sure the flow arrow points out of the hydrostat and into the forward header.
 - B. On the **SP 5020**, make sure the flow arrow points from the hose and into the bottom port of the front wheel motor.
4. After installing hydraulic tester, start engine and run at idle speed. Check for hydraulic leakage and correct before proceeding with test.

5. Operate engine at full speed (**3150 ± 50 RPM**).



CAUTION

Use extreme caution when taking gauge readings. The tires off the ground will be spinning.

6. Slowly push traction pedal into the fully forward position.
7. Slowly close flow control valve on tester until pressure gauge on the hydraulic tester reads **1700 PSI**. As flow control valve is being closed, engine speed will decrease to approximately **2200 RPM** (verify engine speed with a phototac).
8. Observe flow gauge. Tester reading should be minimum flow of **7.5 GPM (28.4 LPM)**. Record test results.
9. Release traction pedal, open flow control valve on tester, and turn off machine.
10. If **1700 PSI (tester pressure), 2200 RPM (engine speed)**, or **7.5 GPM flow** cannot be achieved, consider the following:
 - A. The traction pedal and traction speed may need adjustment (see Adjust Traction Pedal for Neutral and Forward).
 - B. If the engine speed drops excessively (below 2200 RPM) as the traction pump load is applied, engine performance should be evaluated (see Chapter 3 – Briggs & Stratton Vanguard Engines).
 - C. If engine speed does not drop and pressure and flow specifications are not met, the hydrostat needs to be repaired or replaced as necessary.
11. If specifications are met and traction circuit problem exists, check wheel motor efficiency (see TEST NO. 4: Wheel Motor Efficiency in this section).
12. If testing is complete, lower wheels to the ground. Remove hydraulic tester and reconnect hydraulic hose.
13. Make sure hydraulic tank is full (see Check Hydraulic System Fluid).

TEST NO. 2: Charge Relief Valve (R2) and Implement Relief Valve (R1) Pressure

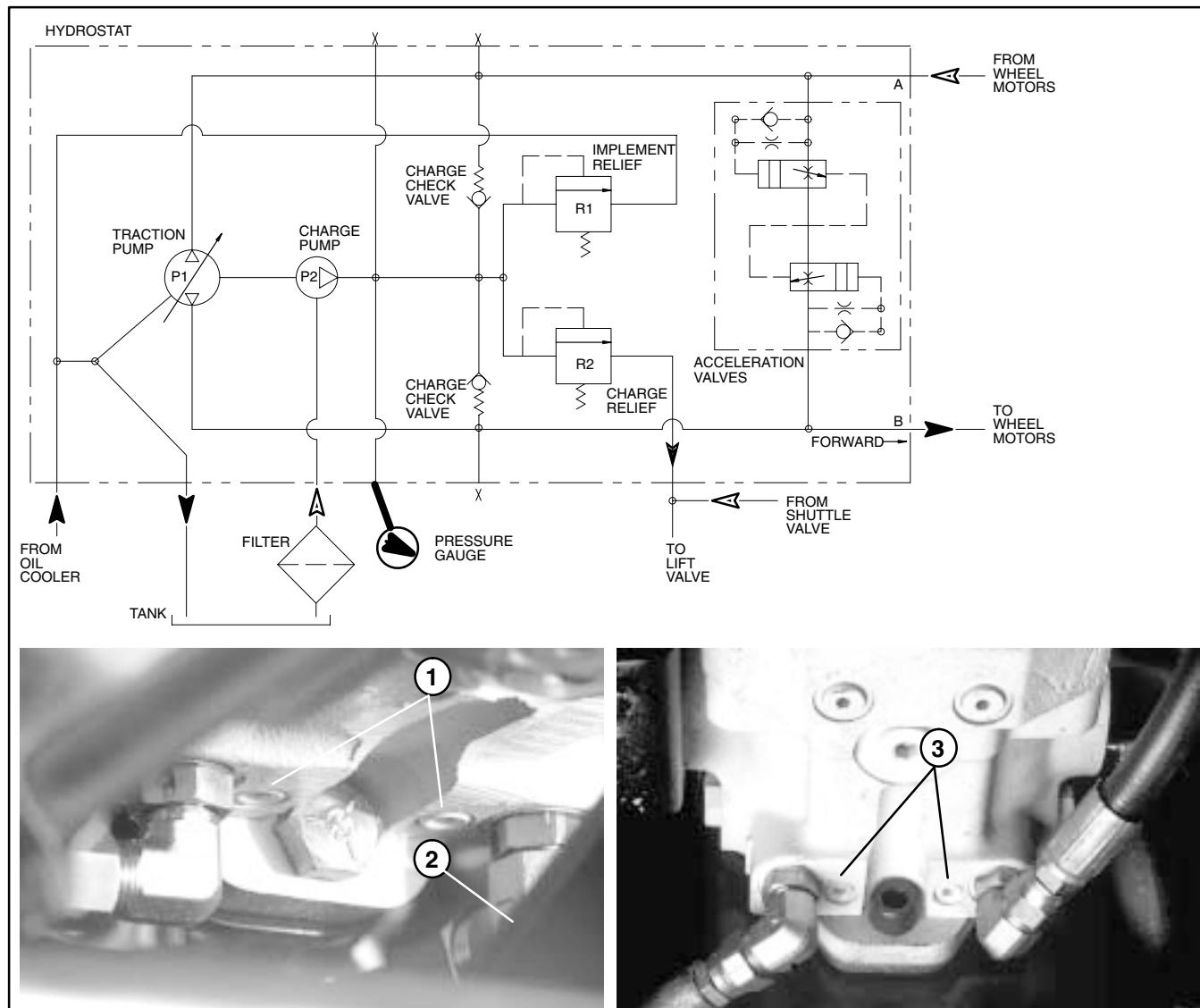


Figure 13

1. Charge test port (SP 2020/3020)

2. Engine base plate (SP 2020/3020)

3. Charge test port (SP 5020)

Procedure for Charge Relief Valve (R2) and Implement Relief Valve (R1) Pressure:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Park machine on a level surface with the attachments lowered. Make sure engine is off. Make sure the parking brake is engaged.



CAUTION

An attachment must be installed to the lift cylinder for the performance of this test to prevent personal injury and damage to the machine.

3. Read Precautions for Hydraulic Testing.

NOTE: On the **SP 2020/3020**, special hydraulic fittings are required to fit the test gauge into the hydrostat test port because of the engine base plate (see Hydraulic Test Fittings in the Special Tools section of this Chapter).

4. Remove plug and install pressure gauge to the hydrostat charge test port.

NOTE: If only implement relief valve (R1) pressure is to be measured, an alternate pressure gauge location is to install a T-connector with pressure gauge in series with the hose from the pump and the T-fitting on the lift valve (Figure 14).

5. Make sure that traction pedal and lift control lever are in neutral and the parking brake is engaged.

6. After installing pressure gauge, start engine and run at low idle speed. Check for hydraulic leakage and correct before proceeding with test.

7. Operate engine at full speed (**3150 ± 50 RPM**). Verify pump hub speed with a phototac.

8. The pressure gauge will display system charge pressure and should read from **170 to 380 PSI**. Record test results.

9. If the specification is not met, replace charge relief valve (R2) (see Hydrostat Service in this Chapter).

10. With the engine still running at full speed (**3150 ± 50 RPM**), lower attachment. Hold lift lever in the lower position to allow the implement relief valve to activate. Pressure gauge should read from **700 to 1000 PSI**. Record test results.

11. If specification is not met, replace implement relief valve (R1) (see Hydrostat Service in this Chapter).

12. Shut off engine.

13. Disconnect gauge and fittings from the hydrostat charge test port. Install and tighten plug to test port.

14. Make sure hydraulic tank is full (see Check Hydraulic System Fluid).

TEST NO. 3: Charge Pump (P2) Flow

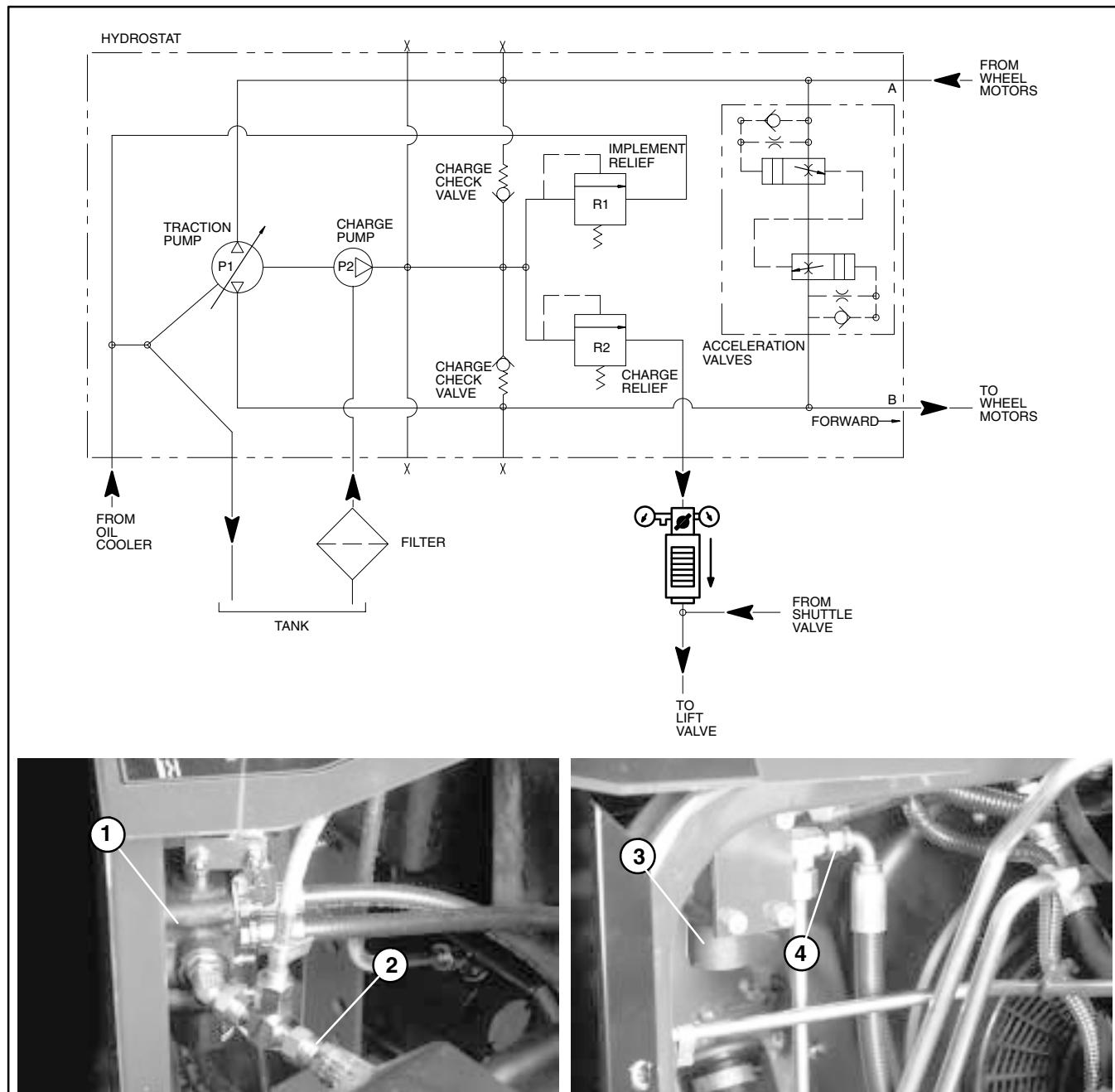


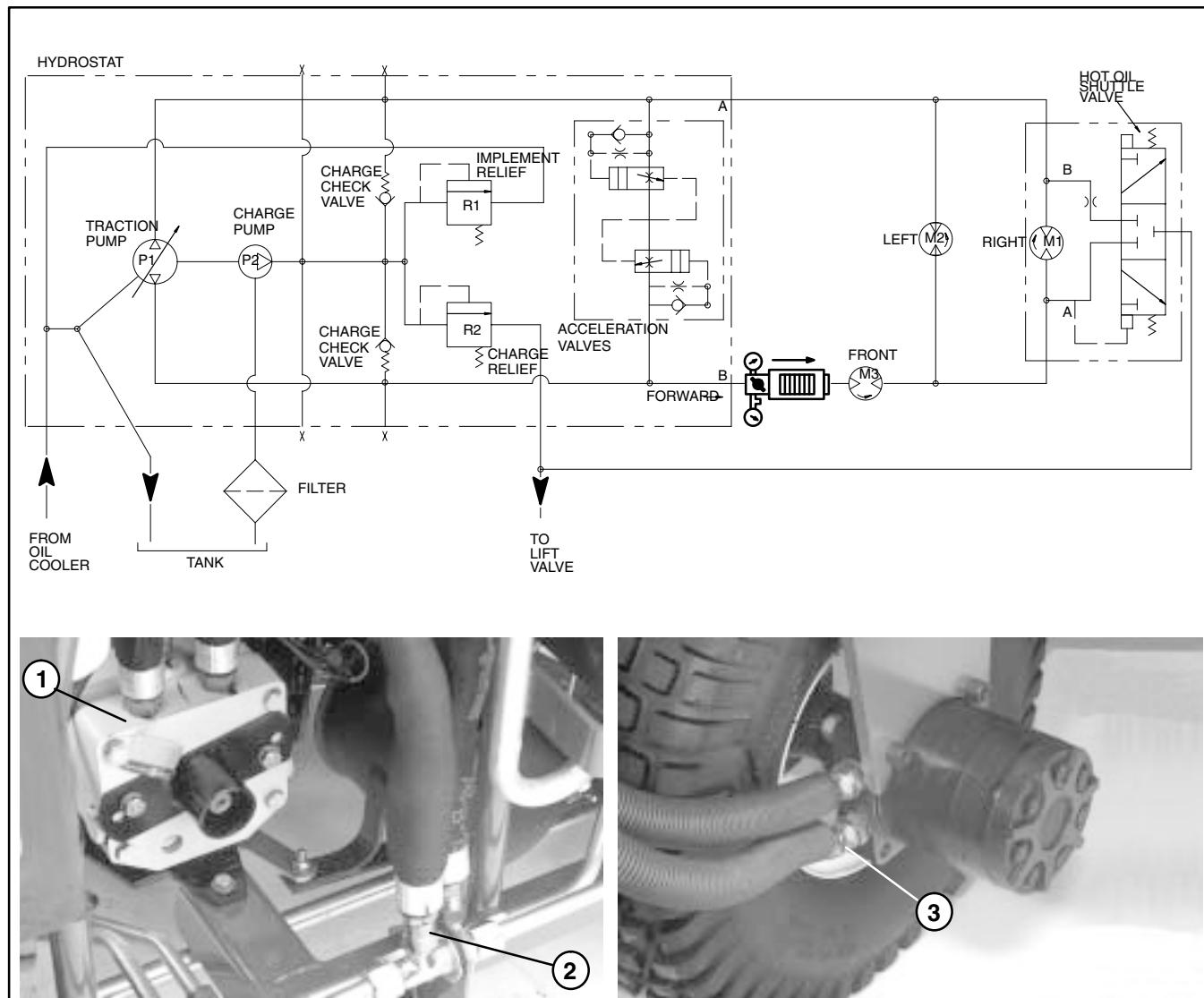
Figure 14

1. Lift valve (SP 2020/3020)
2. Hose from pump (SP 2020/3020)
3. Lift valve (SP 5020)
4. Hose from pump (SP 5020)

Procedure for Charge Pump (P2) Flow:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.
2. Make sure machine is parked on a level surface with the attachments lowered. Make sure engine is off and the parking brake is engaged.
3. Read Precautions for Hydraulic Testing.
4. Disconnect hose from the T-fitting on the lift valve.
5. Install hydraulic tester (flow meter) in series with the hose from the pump and the T-fitting on the lift valve. Make sure the flow arrow points toward the lift valve and the flow control valve on the tester is fully open.
6. Make sure that traction pedal and lift control lever are in neutral and the parking brake is engaged.
7. After installing hydraulic tester, start engine and run at low idle speed. Check for hydraulic leakage and correct before proceeding with test.
8. Operate engine at full speed (**3150 ± 50 RPM**).
9. Slowly close the flow control valve on the tester until **500 PSI** is obtained.
10. Verify pump speed is **3150 ± 50 RPM** with a phototac.
11. Flow indication on tester should be a minimum of **1 GPM (3.8 LPM)**. Record test results.
12. Open the flow control valve on the tester and shut off engine.
13. If flow is less than **1 GPM or 500 PSI** can not be obtained, check for restrictions in the pump circuit. If pump circuit is not restricted, repair or replace charge pump (see Hydrostat Service in this Chapter).
14. Disconnect tester from the hose and T-fitting. Reconnect hose to T-fitting.
15. Make sure hydraulic tank is full (see Check Hydraulic System Fluid).

TEST NO. 4: Wheel Motor Efficiency



Procedure for Wheel Motor Efficiency:

Note: Over a period of time, a wheel motor can wear internally. A worn motor may by-pass oil causing the motor to be less efficient. Eventually, enough oil loss will cause the wheel motor to stall under heavy load conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system, and affect overall machine performance.

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.
2. Park machine on a level surface with the attachments lowered. Make sure engine is off and the parking brake is engaged.
3. Read Precautions for Hydraulic Testing.
4. Make sure that traction pedal is adjusted to the neutral position (see Adjust Traction Drive for Neutral in the Adjustments Section).
5. Attach a heavy chain between the rear of the machine frame and an immovable object to prevent the machine from moving during testing.
6. Install hydraulic tester (flow meter) using the same tester connections as TEST NO. 1: Traction Pump Flow. **Make sure the tester flow control valve is fully open.**
7. Make sure parking brake is engaged. On machines with 3 wheel drive, chock the front wheel to prevent front wheel rotation.
8. After installing hydraulic tester, start engine and run at low idle speed. Check for hydraulic leakage and correct before proceeding with test.



CAUTION

Use extreme caution when performing test. The drive wheels will be trying to move the machine.

9. Move throttle to full speed (**3150 ± 50 RPM**).

10. Slowly push traction pedal in the **forward** direction until **1000 PSI** is displayed on the tester pressure gauge.

11. With all drive wheels locked (not rotating), total internal leakage for all wheel motors will be shown on the flow meter. Flow should be **less than 2 GPM (7.6 LPM)**. Record test results.

12. Release traction pedal and shut engine off.

13. If specification is not met, individual wheel motors need to be removed from the traction circuit to determine which motor(s) is leaking excessively.

A. For SP2020/3020 machines, a wheel motor can be removed from the traction circuit by disconnecting and capping the two hydraulic lines at the motor.

B. For SP5020 machines, the front motor can be removed from the traction circuit by disconnecting the two hydraulic lines at the motor and then connecting the hoses together to allow flow to the rear wheels. A rear motor on a SP5020 can be removed from the traction circuit by disconnecting and capping the two hydraulic lines at the motor.

14. After removing a motor from the circuit, retest using steps 6 through 10 making sure that the remaining drive wheels are locked (not rotating) during testing. When a worn motor is removed from the traction circuit, the test results should show a decrease in leakage flow from the system. Any wheel motor that has leakage **greater than .7 GPM** needs to be repaired or replaced.

Example: consider a SP5020 that has a total internal leakage of 3.5 GPM. When the right, rear wheel motor is disconnected, the system leakage decreases to 1 GPM. The leakage for the disconnected motor is 2.5 GPM which indicates the need to repair or replace the right, rear wheel motor.

Multiple wheel motors may be worn, so efficiency testing of all wheel motors may be required. After an individual motor is tested, reconnect that motor before proceeding to test another motor.

15. After testing is completed, disconnect tester from machine and reconnect all hose connections.

Adjustments

Adjust Traction Pedal for Neutral

If the machine “creeps” when the traction pedal is in the neutral position, the traction cam must be adjusted.

1. Park the machine on a level surface. Turn the engine off.
2. On the **SP 2020/3020**, pivot seat upward and remove engine shield. On the **SP 5020**, remove three cap screws securing side panel to the right side of machine and remove panel.



WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

3. Raise one rear wheel off floor and place support blocks under frame.
4. Loosen locknut on the adjustment cam.



WARNING

The engine must be running to perform the final adjustment of the traction adjustment cam. Guard against possible personal injury. Keep hands, feet, face, and other parts of the body away from rotating parts and hot engine parts such as the muffler.

Adjust Traction Pedal for Forward (SP 2020/3020)

The pedal must be adjusted for forward if the jam nuts on the control rod are loosened or if the pedal is removed.

1. If the jam nuts on the control rod are loosened or the pedal is removed, adjust pedal for forward.
2. Make sure pump is in neutral.
3. Loosen jam nuts on the control rod.
4. Press down on the rear of the pedal until the pedal contacts the footrest.
5. Adjust jam nuts to allow for full stroke of the pump lever in the reverse direction. The control rod must deflect slightly when the pedal is at full stroke.

5. Start engine. Rotate adjustment cam in both directions to determine mid position of neutral span.
6. Tighten lock nut securing the adjustment cam.
7. Stop engine.
8. Remove support blocks and lower the machine. Test drive machine to make sure it does not creep.
9. On the **SP 2020/3020**, install engine shield and pivot seat down. On the **SP 5020**, secure side panel to the right side of machine with three cap screws.

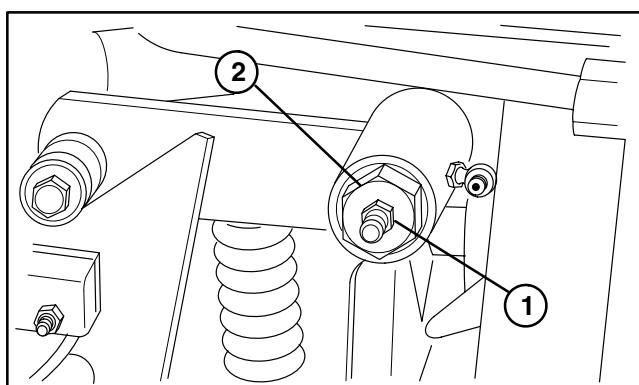


Figure 16

1. Lock nut

2. Adjustment cam

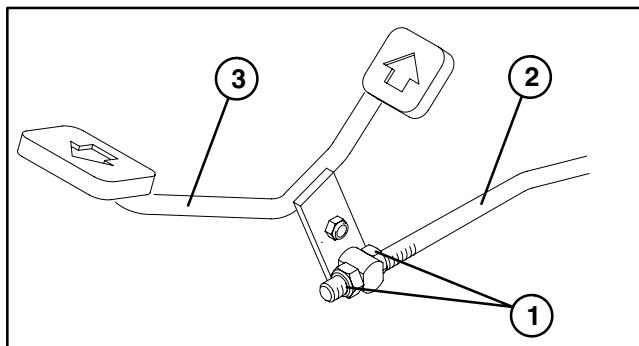


Figure 17

1. Jam nuts
2. Control rod

3. Pedal

Adjust Traction Pedal for Forward (SP 5020)

If the jam nuts on the control rod are loosened or if the pedal is removed, adjusted traction pedal for forward.

1. Park machine on a level surface and turn engine off.
2. Make sure pump is in neutral.
3. Loosen jam nuts on the control rod.
4. Press down on the forward pad of the pedal until the pedal rod contacts the footrest. Tighten jam nuts.

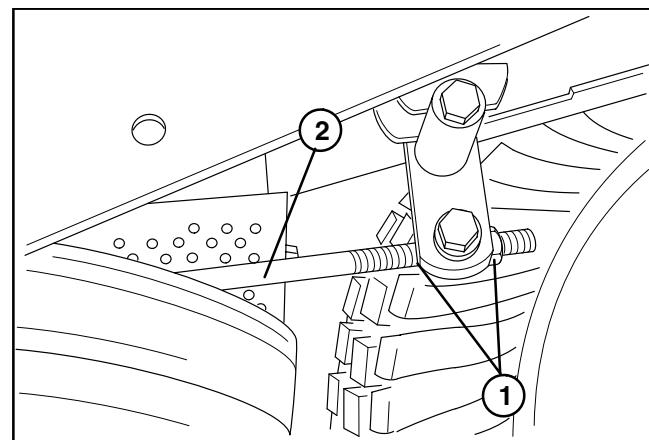


Figure 18

1. Jam nuts

2. Control rod

Adjust Lift Lever (SP 2020/3020)

The lift lever should be adjusted if the attachment does not float (follow ground contour) properly during operation.

1. Park machine on a level surface. Turn engine off and engage parking brake.
2. Disconnect attachment from lift cylinder. Extend cylinder part way.
3. Loosen capscrews and locknuts securing the lever guide to the valve shroud.
4. Move lever guide until the cylinder moves freely when the lift lever is in the detent position.
5. Tighten capscrews and locknuts to lock in adjustment.

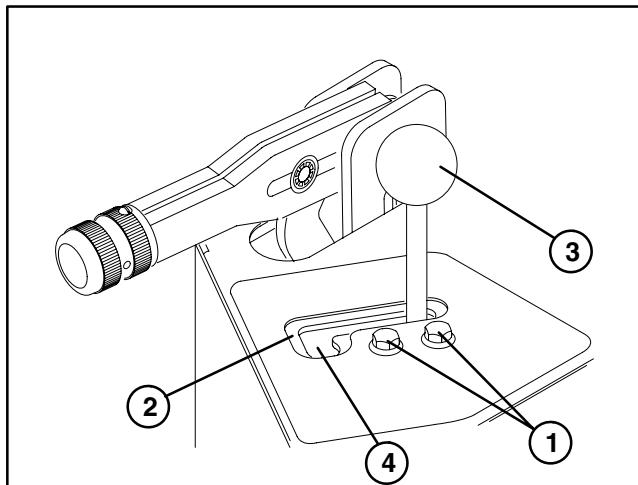


Figure 19

1. Cap screws
2. Lever guide
3. Lift lever
4. Detent position

Adjust Lift Lever (SP 5020)

The lift lever detent plate should be adjusted if the attachment does not float (follow ground contour) properly during operation.

1. Park the machine on a level surface, turn engine off, set parking brake, and block wheels.
2. Loosen both capscrews securing lift lever detent plate to the fender and frame.
3. Insert a 3/16-inch hex key through the access hole of the front fender and into the jacking screw of the lift lever detent plate.



WARNING

The engine must be running so final adjustment of the lift lever detent plate can be performed. To guard against possible personal injury, keep hands, feet, face and other parts of the body away from the muffler, other hot parts of the engine and other rotating parts.

4. Start engine.
5. With engine running and lift lever in the FLOAT position, rotate jacking screw until the lift cylinder can be extended and retracted by hand.
6. Tighten both lift lever detent plate cap screws to secure adjustment.

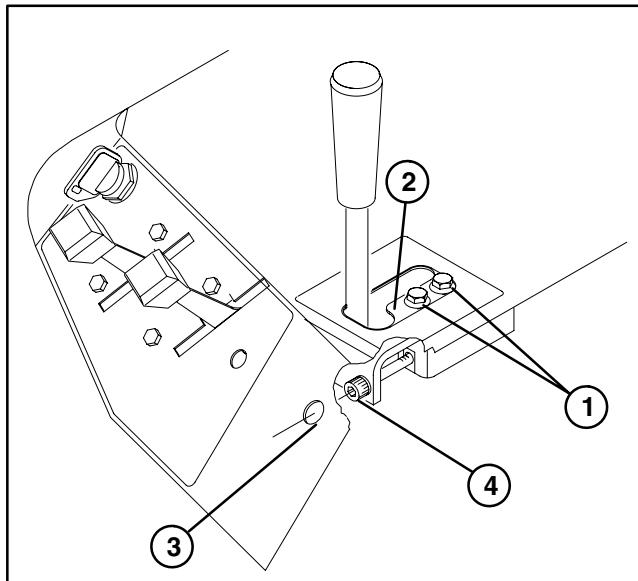


Figure 20

1. Cap screws
2. Detent plate
3. Access hole
4. Jacking screw

Service and Repairs

Check Hydraulic Lines and Hoses



WARNING

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

Check hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings, weather deterioration and chemical deterioration. Make all necessary repairs before operating.

Charge Hydraulic System

NOTE: When initially starting the hydraulic system with new or rebuilt components such as motors, pumps, or lift cylinders, it is important that the hydraulic system be charged properly. Air must be purged from the system and its components to reduce the chance of damage.

IMPORTANT: Change hydraulic oil filter whenever hydraulic components are repaired or replaced.

1. Park machine on a level surface, and turn the engine off.
2. Make sure all hydraulic connections, lines, and components are secured tightly.
3. If component failure was severe or the system is contaminated, flush and refill hydraulic system and tank (see Flush Hydraulic System).
4. Make sure hydraulic tank is full. Add correct oil if necessary (see Check Hydraulic System Fluid).
5. Disconnect spark plug leads to prevent the engine from starting.
6. Check control linkage to the hydrostat for proper adjustment, binding, or broken parts.
7. Make sure traction pedal and the lift control lever are in the **neutral** position. Turn ignition key switch; engage starter for **fifteen (15) seconds** to prime the traction and charge pumps.
8. Reconnect spark plug leads.
9. On the **SP 2020/3020**, pivot seat upward and remove engine shield. On the **SP 5020**, remove cap screws that secure side panel to right side of machine.

10. Loosen lock nut on spring adjusting pin until bearing moves freely from cam. The pump shaft must be free to rotate during start-up.



WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

11. Raise one rear wheel off the floor, and place support blocks under frame. Chock remaining wheels to prevent movement of the machine.

12. Make sure traction pedal and lift control lever are in **neutral**. Start engine and run it at low idle of **1800 rpm**. The charge pump should pick up oil and fill the hydraulic system. If there is no indication of fill in 30 seconds, stop the engine and determine the cause.

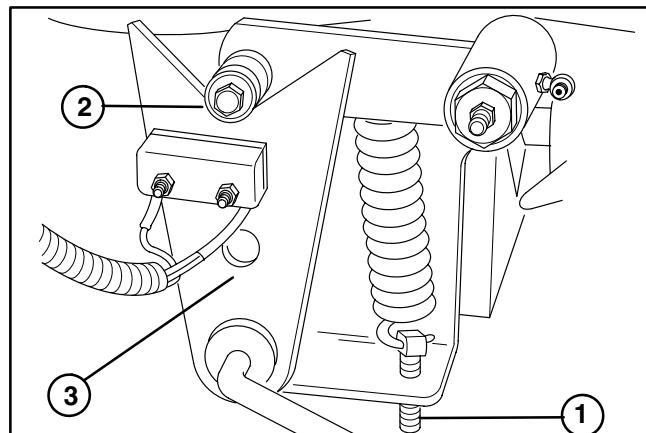


Figure 21

1. Spring adjusting pin
2. Bearing
3. Cam

13. After the hydraulic system starts to show signs of fill, actuate lift control lever until the lift cylinder rod moves in and out several times. If the cylinder rod does not move after 10 to 15 seconds, or the pump emits abnormal sounds, shut the engine off immediately and determine cause or problem. Inspect for the following:
- A. Loose filter or suction lines.
 - B. Loose or faulty coupler on the pump.
 - C. Blocked suction line.
 - D. Faulty charge relief valve.
 - E. Faulty charge pump.
14. If cylinder moves in 10 to 15 seconds, proceed to step 15.
15. Operate the traction pedal in the forward and reverse directions. The wheel off the floor should rotate in the proper direction.
- A. If the wheel rotates in the wrong direction, stop engine, remove lines from rear of pump, and reverse the connections.
 - B. If the wheel rotates in the proper direction, stop engine and adjust the spring adjusting pin lock nut.
16. Adjust traction pedal to the neutral position (see Adjust Traction Pedal for Neutral).
17. On the **SP 2020/3020**, install engine shield and pivot seat down. On the **SP 5020**, secure panel to right side of machine with cap screws.
18. Check operation of the traction interlock switch (see Check Interlock System in Chapter – 5, Electrical Systems).
19. Remove block from wheels and lower machine. Remove chocks from remaining wheels.
20. If the traction pump or a wheel motor was replaced or rebuilt, run the traction unit so all wheels turn slowly for 10 minutes.
21. Operate traction unit by gradually increasing its work load to full over a 10 minute period.
22. Stop the machine. Check tank and fill if necessary. Check hydraulic components for leaks and tighten any loose connections.

Change Hydraulic System Fluid and Filter

The hydraulic system filter must be changed initially after the first 8 hours of operation. Thereafter, it must be changed every 400 hours of operation or yearly, whichever comes first. Use a genuine Toro oil filter for replacement. The hydraulic oil must be changed every 400 hours of operation or yearly, whichever comes first.

1. Park machine on a level surface and turn the engine off.
2. On the **SP 2020/3020**, pivot seat up. On the **SP 5020**, remove three cap screws securing the right side panel to the machine and remove panel.
3. On the **SP 2020/3020**, disconnect tube from the bottom fitting of the hydraulic tank. Let oil flow into a drain pan. Reinstall and tighten tube connection when oil stops draining.
4. On the **SP 5020**, place a funnel under the tank drain plug to direct oil into a drain pan. Remove drain plug and allow oil to drain into pan. Reinstall and tighten drain plug when the oil stops draining (Fig. 22).
5. Clean area around the hydraulic oil filter. Remove filter from the filter head. Allow oil to flow into a drain pan. Dispose of the oil filter properly (Fig 23 or 24).
6. Apply a film of clean hydraulic oil on the filter gasket. Install filter by hand until gasket contacts filter head, then tighten filter an additional three-fourths of a turn.
7. Fill tank to the proper level (see Check Hydraulic System Fluid).
8. Make sure traction pedal and lift lever are in the **neutral** position. Start engine. Run engine at lowest possible RPM to purge the system of air.
9. Run engine until the lift cylinder can be extended and retracted and wheel motion in the forward and reverse direction is achieved.
10. Stop engine and check oil level in the tank. Add oil if necessary.
11. Check all hydraulic connections for leaks.
12. On the **SP 2020/3020**, pivot seat down. On the **SP 5020**, install right side panel and secure with three cap screws.
13. Dispose of oil properly.

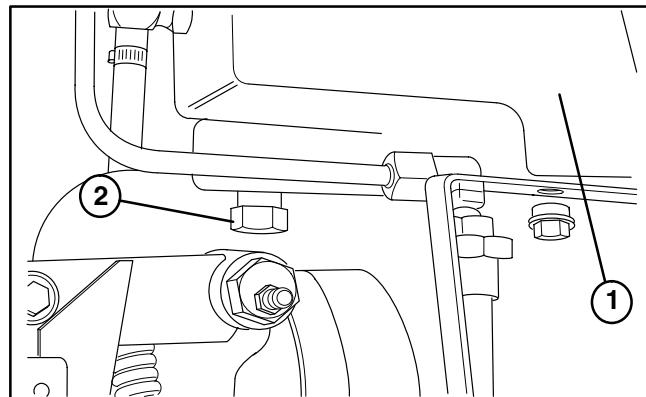


Figure 22

1. Tank (SP 5020) 2. Drain plug

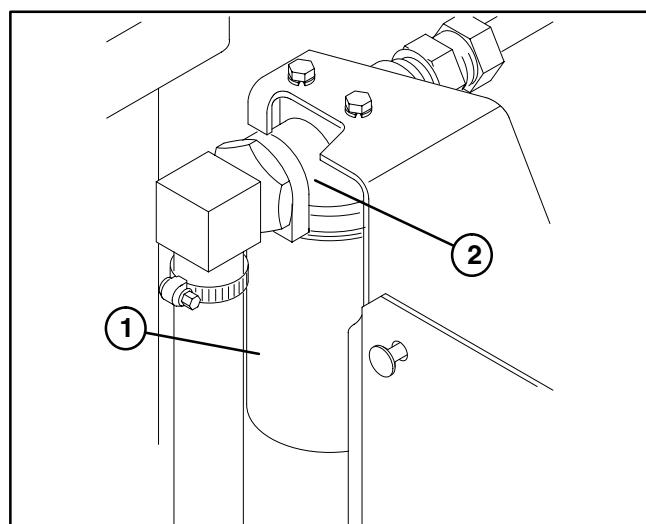


Figure 23

1. Filter (SP 2020/3020) 2. Filter head

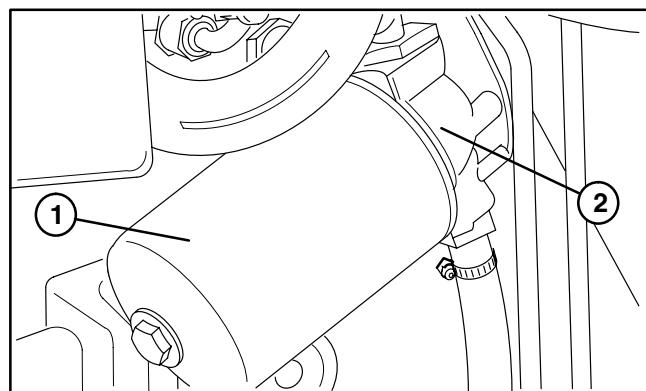


Figure 24

1. Filter (SP 5020) 2. Filter head

Lift Valve (SP 2020/3020)

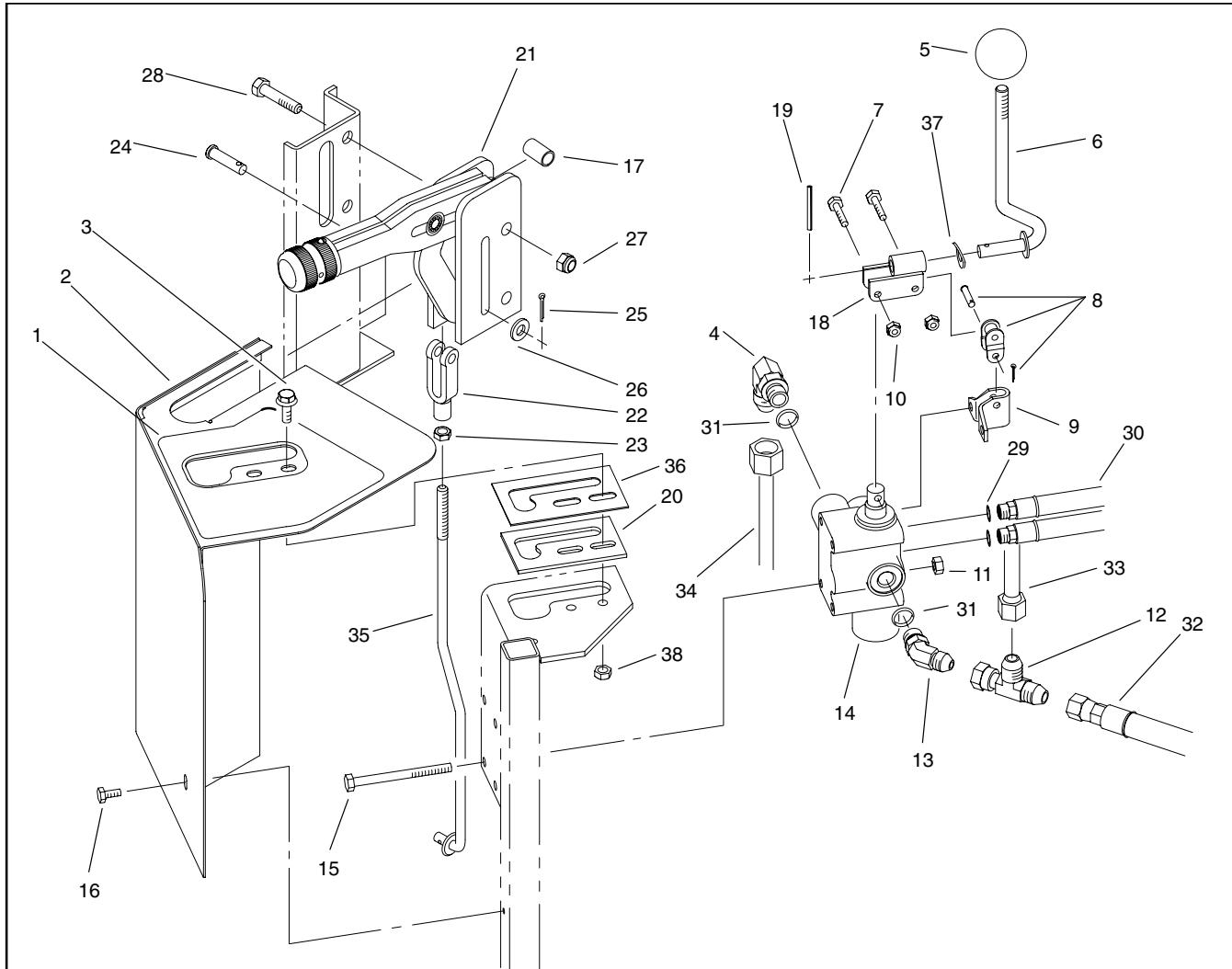


Figure 25

- | | | |
|---------------------------|-------------------------|------------------------|
| 1. Control panel decal | 14. Lift valve | 27. Lock nut |
| 2. Lift valve shroud | 15. Cap screw | 28. Cap screw |
| 3. Cap screw | 16. Self tapping screw | 29. O-ring |
| 4. 90° hydraulic fitting | 17. Seat support spacer | 30. Hydraulic hose |
| 5. Knob | 18. Pivot | 31. O-ring |
| 6. Lift lever | 19. Spring pin | 32. Hydraulic hose |
| 7. Cap screw | 20. Valve lever latch | 33. Shuttle valve tube |
| 8. Offset link | 21. Brake lever | 34. Hydraulic tube |
| 9. Pivot bracket | 22. Clevis | 35. Brake rod |
| 10. Lock nut | 23. Hex nut | 36. Lift lever guide |
| 11. Lock nut | 24. Clevip pin | 37. Wave washer |
| 12. Swivel run T-fitting | 25. Cotter pin | 38. Lock nut |
| 13. 45° hydraulic fitting | 26. Flat washer | |

Removal (Fig. 25)

1. Before removing any parts from the hydraulic system, park machine on a level surface, engage parking brake, lower attachment, and stop engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

2. Remove cover from the midsection of the machine. Pivot seat up. Unscrew knob (5) from lift lever (6).
3. Remove lift valve shroud (2) as follows:
 - A. Remove self tapping screw (16) from the shroud and frame.
 - B. Remove both cap screws (3) and lock nuts (38) securing the shroud, lift lever guide (36), and valve lever latch (20) to the frame.
 - C. Lift shroud from the frame.
4. Clean lift valve (14) and all hydraulic fittings, tubes, and hoses attached to it thoroughly.
5. Label all hydraulic connections for reassembly.
6. Disconnect both hydraulic hoses (30) from the lift valve. Disconnect swivel run T-fitting (12) from the 45° hydraulic fitting (13). Disconnect hydraulic tube (34) from the 90° hydraulic fitting (4). Allow hoses, tubes, and fittings to drain into a suitable container.
7. Put caps or plugs on disconnected hoses, tubes, and fittings to prevent contamination.
8. Remove cap screw (7) and lock nut (10) securing the pivot (18) to the lift valve stem.
9. Remove four cap screws (15) and lock nuts (11) securing the pivot bracket (9) to the lift valve and the lift valve to the frame. Separate lift valve from the frame. **Do not further disassemble parts assembled to the lift lever.**
- IMPORTANT: Match mark positions of hydraulic fittings (4 and 13) relative to their ports on the lift valve.**
10. Remove remaining hydraulic fittings (4 and 13) and O-rings (31) from the lift valve.

Installation (Fig. 25)

1. Make sure lift valve, hydraulic hoses, fittings, and tubes are cleaned thoroughly.
2. Reinstall O-rings (31) and hydraulic fittings (4 and 13) to the lift valve. Observe match marks when tightening.
3. Position lift valve (14) to the frame. Insert four cap screws (15) through the frame and lift valve. Screw lock nuts (11) to the bottom two cap screws (15).
4. Position lift lever (6) through the frame and attached pivot bracket (9) and other attached parts onto the top two cap screws (15). Screw lock nuts (11) to the top two cap screws (15). Tighten all four lock nuts.
5. Secure pivot (18) to the lift valve stem with cap screw (7) and lock nut (10). Tighten fasteners.
6. Remove caps and plugs from the disconnected hoses, tubes, and fittings
7. Reconnect hydraulic tube (34) to the 90° hydraulic fitting (4). Reconnect swivel run T-fitting (12) to the 45° hydraulic fitting (13). Reconnect both hydraulic hoses (30) with O-rings (29) to the lift valve. Tighten all connections.
8. Attach lift valve shroud (2) as follows:
 - A. Position valve lever latch (20) and lift lever guide (36) over the lift lever and onto the frame.
 - B. Insert both cap screws (3) to the shroud.
 - C. Lower shroud around lift lever (6) and onto frame. Make sure cap screws go through lift lever guide (36) and valve lever latch (20).
 - D. Attach lock nuts (38) to cap screws. **Do not tighten fasteners.**
 - E. Reinstall self tapping screw (16) to the shroud and frame. Tighten screw.
9. Screw knob (5) onto the lift lever (6). Hand tighten.
10. Charge hydraulic system (see Charge Hydraulic System).
11. Run machine and check lift valve, hydraulic hoses, tubes, and fittings for leaks. Tighten as necessary.
12. Adjust lift lever (6) (see Adjust Lift Lever).
13. Reinstall cover to the midsection of the machine.

Lift Valve (SP 5020)

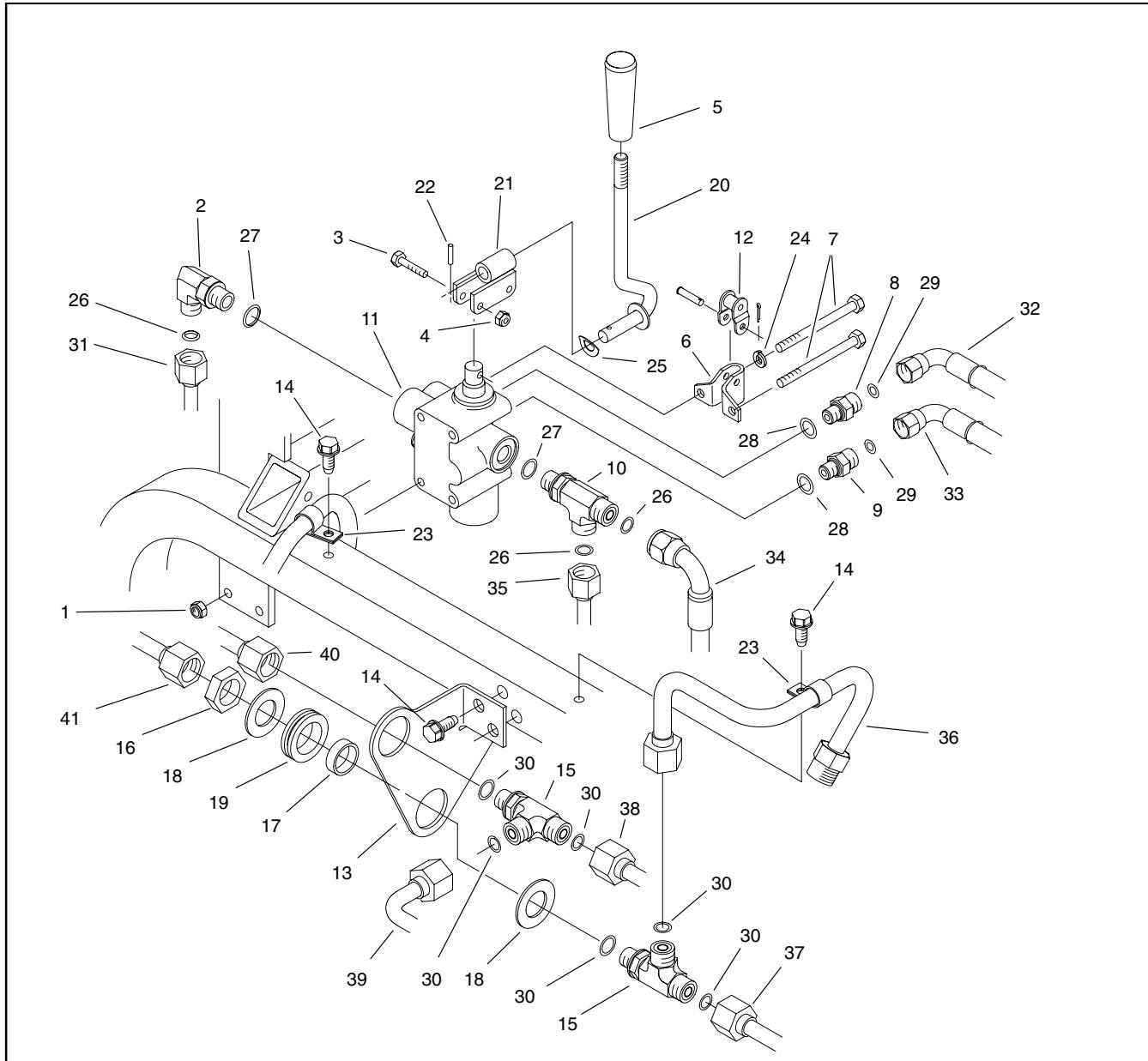


Figure 26

- | | | |
|-------------------------------|-------------------------|--------------------|
| 1. Lock nut | 15. Hydraulic T-fitting | 29. O-ring |
| 2. 90° hydraulic fitting | 16. Bulkhead nut | 30. O-ring |
| 3. Cap screw | 17. Spacer | 31. Hydraulic tube |
| 4. Lock nut | 18. Washer | 32. Hydraulic hose |
| 5. Lever knob | 19. Grommet | 33. Hydraulic hose |
| 6. Pivot bracket | 20. Lift lever | 34. Hydraulic hose |
| 7. Cap screw | 21. Welded pivot | 35. Hydraulic tube |
| 8. Hydraulic orifice fitting | 22. Spring pin | 36. Hydraulic tube |
| 9. Hydraulic straight fitting | 23. R-clamp | 37. Hydraulic tube |
| 10. Hydraulic T-fitting | 24. Lock washer | 38. Hydraulic tube |
| 11. Lift valve | 25. Curved washer | 39. Hydraulic tube |
| 12. Offset link | 26. O-ring | 40. Hydraulic tube |
| 13. Bulkhead bracket | 27. O-ring | 41. Hydraulic tube |
| 14. Self tapping screw | 28. O-ring | |

Removal (Fig. 26)

1. Before removing any parts from the hydraulic system, park machine on a level surface, engage parking brake, lower attachment, and stop engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

2. Remove cover from the midsection of the machine. Unscrew knob (5) from lift lever (20).
3. Remove control panel (right fender) to gain access to the lift valve (see Control Panel Removal in Chapter 6 – Wheels, Brakes, and Miscellaneous).
4. Clean lift valve assembly (11) and all hydraulic fittings, tubes, and hoses attached to it thoroughly.
5. Label all hydraulic connections for reassembly.
6. Disconnect both hydraulic hoses (32 and 33) and O-rings (29) from hydraulic fittings (8 and 9). Allow hoses and fittings to drain into a suitable container.
7. Disconnect hydraulic hose (34), hydraulic tube (35), and O-rings (26) from hydraulic T-fitting (10). Allow hose, tube, and fitting to drain into a suitable container.
8. Disconnect hydraulic tube (31) and O-ring (26) from 90° hydraulic fitting (2). Allow tube and fitting to drain into a suitable container.
9. Put caps or plugs on disconnected hoses, tubes, and fittings to prevent contamination.
10. Remove cap screw (3) and lock nut (14) securing the welded pivot (21) to the lift valve stem.
11. Remove four cap screws (7), lock washer (24) and lock nuts (1) securing the pivot bracket (6) to the lift valve and the lift valve to the frame. Separate lift valve from the frame. **Do not further disassemble parts assembled to the lift lever.**
- IMPORTANT: Match mark positions of hydraulic fittings (2,8,9 and 10) relative to their ports on the lift valve.**
12. Remove remaining hydraulic fittings (2, 8, 9, and 10) and O-rings (27 and 28) from the lift valve.

Installation (Fig. 26)

1. Make sure lift valve, hydraulic hoses, fittings, and tubes are cleaned thoroughly.
2. Reinstall O-rings (27 and 28) and hydraulic fittings (2, 8, 9, and 10) to the lift valve. Observe match marks when tightening.
3. Position lift valve to the frame. Insert two cap screws (7) through the bottom two holes of frame bracket frame and lift valve. Screw lock nuts (1) to the bottom two cap screws (7).
4. Position lift lever to the lift valve. Insert two cap screws (7) through flat washer (24), pivot bracket (6), and top two holes of lift valve and frame bracket. Screw lock nut (1) to the top cap screw (7). Tighten all three lock nuts and four cap screws.
5. Secure welded pivot (21) to the lift valve stem with cap screw (3) and lock nut (4). Tighten fasteners.
6. Remove caps and plugs from the disconnected hoses, tubes, and fittings
7. Reconnect hydraulic tube (31) and O-ring (26) to 90° hydraulic fitting (2).
8. Reconnect hydraulic hose (34), hydraulic tube (35), and O-rings (26) to hydraulic T-fitting (10).
9. Reconnect both hydraulic hoses (32 and 33) and O-rings (29) to hydraulic fittings (8 and 9).
10. Reinstall control panel (see Control Panel Installation in Chapter 6 – Wheels, Brakes, and Miscellaneous).
11. Charge hydraulic system (see Charge Hydraulic System).
12. Run machine and check lift valve, hydraulic hoses, tubes, and fittings for leaks. Tighten as necessary.
13. Adjust lift lever (20) (see Adjust Lift Lever).

Lift Valve

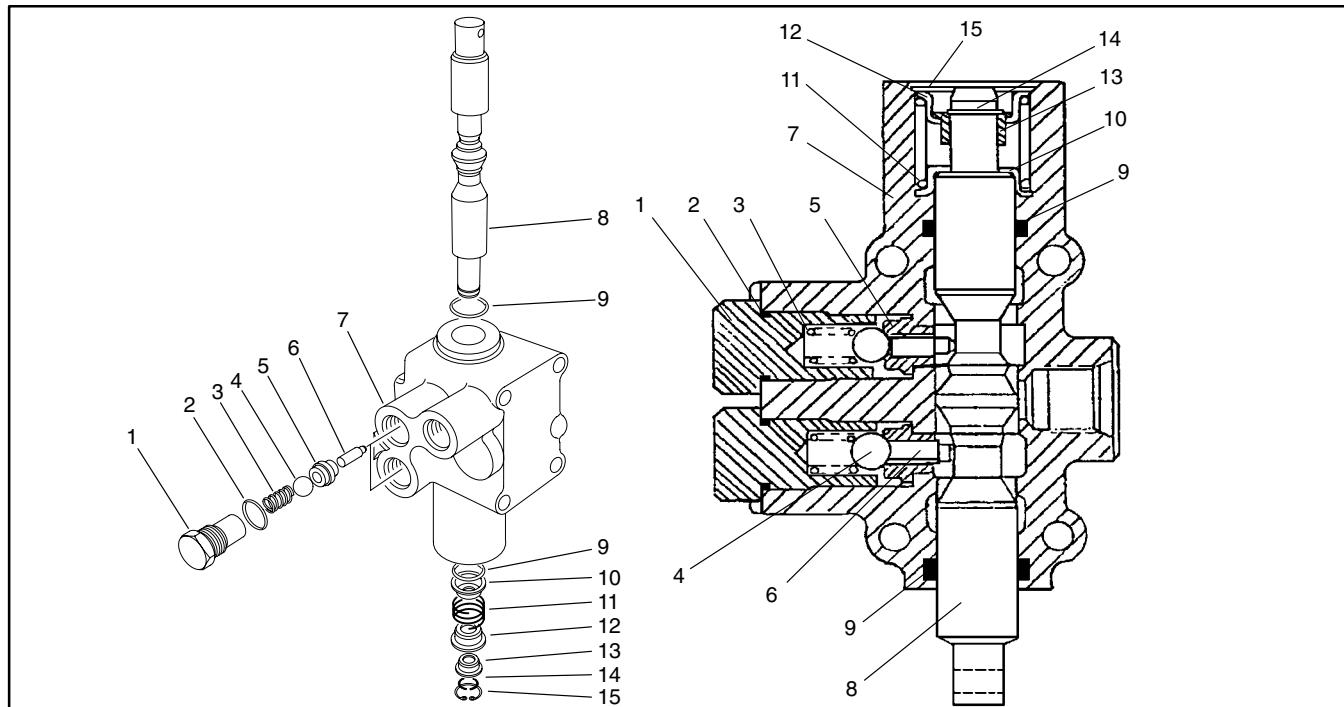


Figure 27

- 1. Plug
- 2. O-ring
- 3. Spring
- 4. Ball
- 5. Check valve seat

- 6. Cam pin
- 7. Body
- 8. Spool
- 9. O-ring
- 10. Spring retainer

- 11. Spring
- 12. Spring retainer
- 13. Spacer float
- 14. Spool retaining ring
- 15. Retaining ring

Disassembly

1. Wash valve in solvent and dry thoroughly.
2. Mount valve carefully in a vise so that the retaining ring is facing up and the mounting pads are against the jaws of the vise.
3. Remove plug and O-ring from the valve body. Remove spring, ball, and cam pin.
4. Remove spool retaining ring from the spool. Push and twist spool carefully out of the body.
5. Remove spacer float from the spring retainer.
6. Remove retaining ring from the body. Remove spring retainer, spring, and spring retainer from the body.
7. Use hooked scribe to remove both O-rings from the body. **Be careful not to scratch bore finish.**

Inspection

1. Inspect spool for wear and flatness. Wear on one side of the spool may indicate a bent spool. Replace spool if necessary.

2. Inspect check valve seat for wear and damage of sealing surface. Replace if necessary.

3. Inspect ball for wear, damage, and flat spots. Replace if necessary.

Reassembly

1. Clean and dry all parts thoroughly. Coat all O-rings with clean hydraulic fluid.
2. Use hooked scribe to install both O-rings into the grooves of the body bore.
3. Install spring retainer, spring, and spring retainer into the body. Secure with retaining ring.
4. Install spacer float into the spring retainer.
5. Coat spool with clean hydraulic oil. Push and twist spool carefully into the body. Secure spool with spool retaining ring.
6. Install cam pin, ball, and spring into the body. Install O-ring and plug into the body. Tighten plug.

Lift Cylinder (SP 2020/3020)

Removal

1. Before removing any parts from the hydraulic system, park the machine on a level surface, engage the parking brake, lower attachment, and stop the engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

2. Label all hydraulic connections for reassembly.
3. Disconnect hydraulic hoses and O-rings from the hydraulic fittings. Allow hoses to drain into a suitable container.
4. Put caps or plugs on disconnected hoses and fittings to prevent contamination.
5. Remove cotter pin from the clevis pin. Pull clevis pin from the hydraulic cylinder and lift arm.
6. Support hydraulic cylinder to prevent it from dropping.
 - A. Remove a cotter pin from the cylinder pin.
 - B. Pull cylinder pin from the hydraulic cylinder and frame.
 - C. Remove hydraulic cylinder from the frame.

Installation

1. Position hydraulic cylinder to the frame. Insert cylinder pin through the frame bracket and cylinder. Secure pin with cotter pins.
2. Position clevis of the hydraulic cylinder to the lift arm. Insert clevis pin through the cylinder clevis and secure with cotter pins.
3. Remove caps or plugs from the disconnected hose and fittings. Connect hydraulic hoses and O-rings to the hydraulic fittings. Tighten hose connections.
4. Charge hydraulic system (see Charge Hydraulic System).

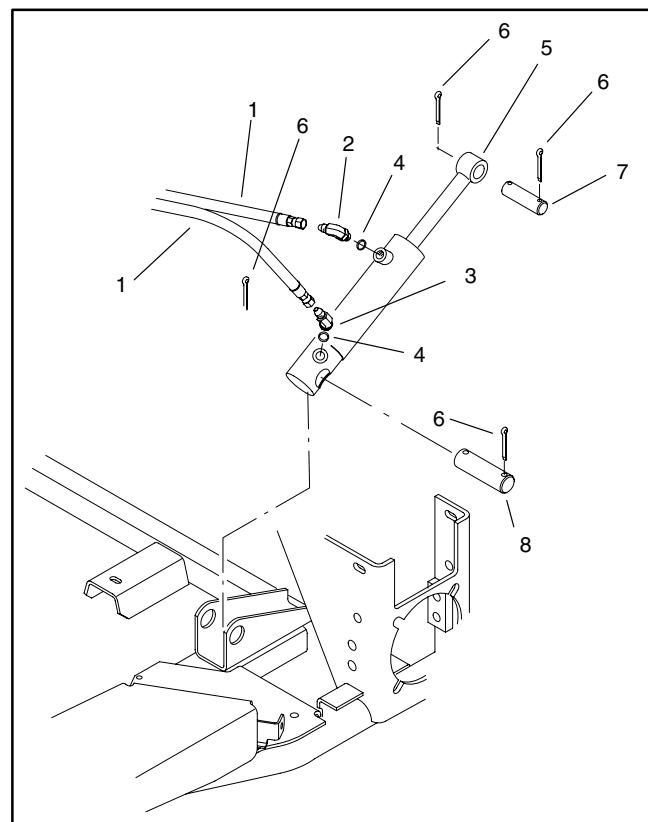


Figure 28

- | | |
|--------------------------|--------------------------|
| 1. Hydraulic hose | 5. Hydraulic cylinder |
| 2. 90° Hydraulic fitting | 6. Cotter pin |
| 3. 45° Hydraulic fitting | 7. Cylinder pin (clevis) |
| 4. O-ring | 8. Cylinder pin |

Lift Cylinder(SP 5020)

Removal

1. Before removing any parts from the hydraulic system, park the machine on a level surface, engage the parking brake, lower the cutting units, and stop the engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

2. Label all hydraulic connections for reassembly.
3. Disconnect hydraulic hoses and O-rings from the hydraulic fittings. Allow hoses to drain into a suitable container.
4. Put caps or plugs on disconnected hoses and fittings to prevent contamination.
5. Remove both hair pins from the cylinder pin. Pull cylinder pin from the lift cylinder, spacer, and lift arm.
6. Support lift cylinder to prevent it from dropping.
 - A. Remove cap screw and flat washer from the cylinder support.
 - B. Remove lift cylinder from the support.

Installation

1. Position lift cylinder to the frame. Install lift cylinder to the cylinder support. Secure cylinder to the support with flat washer and cap screw.
2. Position clevis of the lift cylinder to the lift arm and spacer. Insert cylinder pin through the cylinder clevis, lift arm, and spacer. Secure cylinder pin with both hair pins.
3. Remove caps or plugs from the disconnected hoses and fittings. Connect hydraulic hoses and O-rings to the hydraulic fittings. Tighten hose connections.
4. Charge hydraulic system (see Charge Hydraulic System).

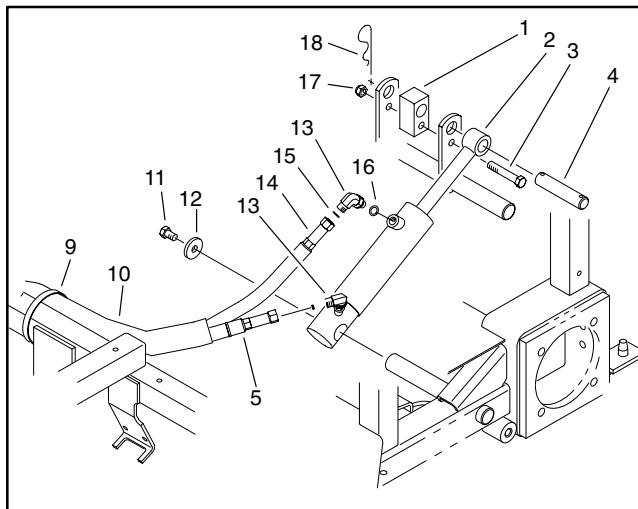


Figure 29

- | | |
|-----------------------|---------------------------|
| 1. Spacer | 10. Protective sleeve |
| 2. Hydraulic cylinder | 11. Cap screw |
| 3. Cap screw | 12. Washer |
| 4. Cylinder pin | 13. 90° hydraulic fitting |
| 5. Hydraulic hose | 14. Hydraulic hose |
| 6. Cylinder support | 15. O-ring |
| 7. Not used | 16. O-ring |
| 8. Not used | 17. Lock nut |
| 9. Not used | 18. Hair pin |

Lift Cylinder Service

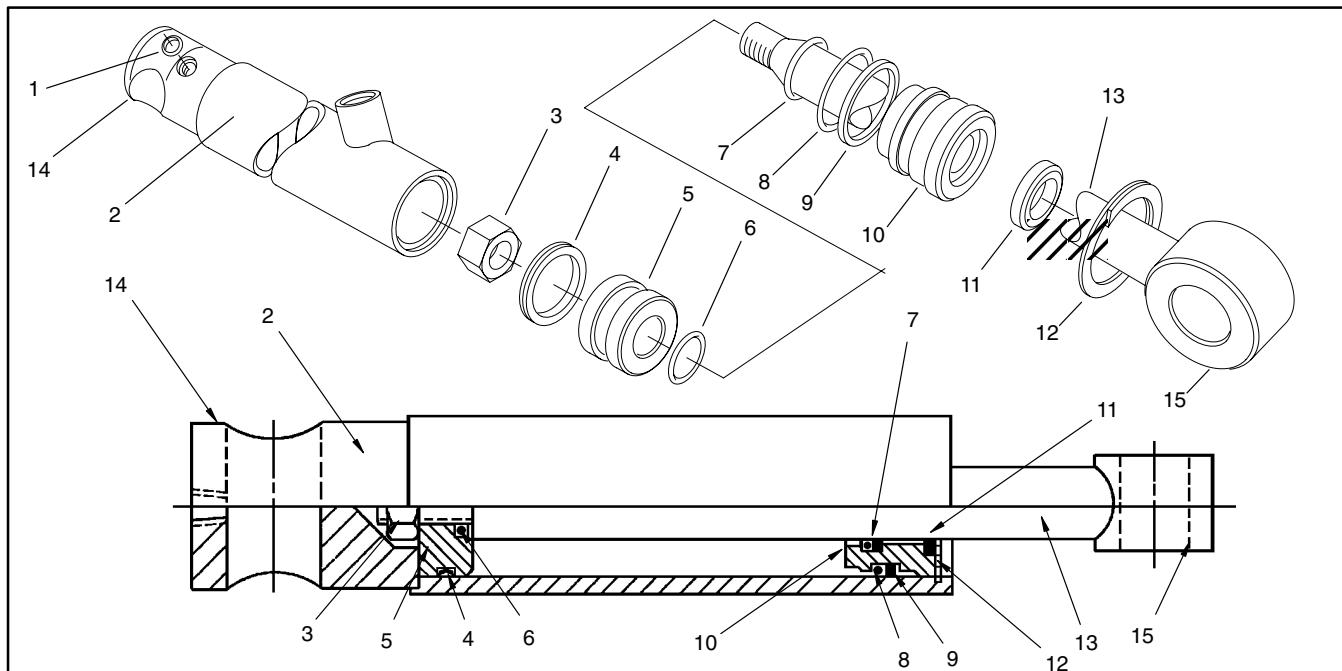


Figure 30

- 1. O-ring
- 2. Barrel
- 3. Nut
- 4. Uni-ring
- 5. Piston

- 6. O-ring
- 7. Poly-pack
- 8. O-ring
- 9. Back-up ring
- 10. Head

- 11. Dust seal
- 12. Retaining ring
- 13. Shaft (w/clevis)
- 14. Pivot end
- 15. Clevis

Disassembly

1. Remove oil from the hydraulic cylinder into a drain pan by slowly pumping the cylinder shaft. Plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on pivot end only. Do not close vise enough to distort the barrel.

2. Mount hydraulic cylinder in a vice. Remove dust seal and retaining ring.

3. Extract shaft, head, and piston by carefully twisting and pulling on the shaft.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vice.

4. Mount shaft securely in a vise by clamping on the clevis of the shaft. Remove lock nut and piston from the shaft. Slide head off the shaft.

5. Remove Uni-ring and O-ring from the piston. Remove poly-pack, O-ring, and back-up ring from the head.

Reassembly

1. Make sure all parts are clean before reassembly.

2. Coat new O-rings, Uni-rings, poly-pack, back-up ring, and dust seal with clean hydraulic oil. Install Uni-ring and O-ring to the piston. Install poly-pack, O-ring, and back-up ring to the head.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vice.

3. Mount shaft securely in a vise by clamping on the clevis of the shaft. Slide head onto the shaft. Install piston and lock nut onto the shaft. Tighten lock nut. Remove shaft from the vise.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on pivot end only. Do not close vise enough to distort the barrel.

4. Mount barrel in a vice.

5. Coat all internal parts with a light coat of clean hydraulic oil. Slide piston, shaft, and head assembly into the barrel being careful not to damage the seals.

6. Secure head in the barrel with the retaining ring.

Hydrostat (SP 2020/3020)

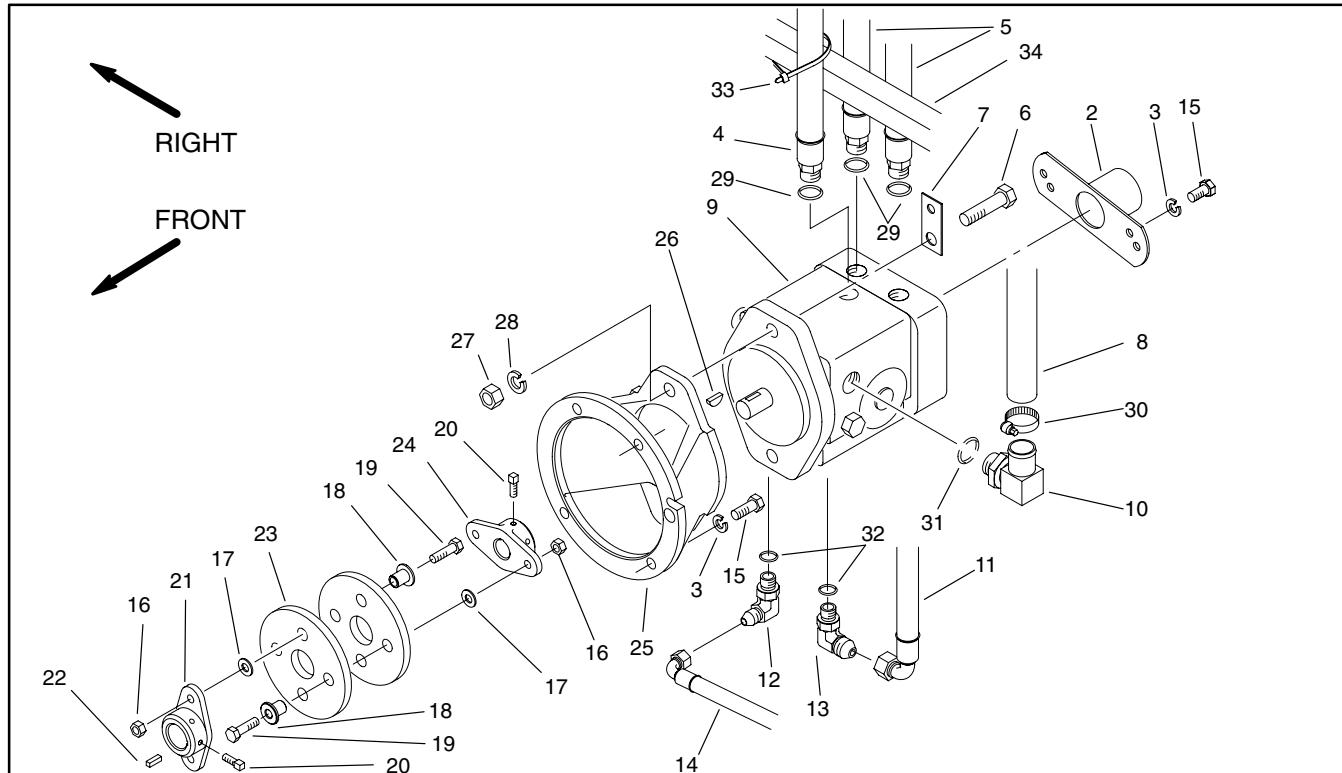


Figure 31

- | | | |
|---------------------------|---------------------------|--------------------|
| 1. Not used | 13. 90° hydraulic fitting | 24. Pump hub |
| 2. Shaft cover | 14. Hydraulic hose | 25. Pump mount |
| 3. Lock washer | 15. Cap screw | 26. Woodruff key |
| 4. Hydraulic hose | 16. Lock nut | 27. Hex nut |
| 5. Hydraulic hose | 17. Flat washer | 28. Lock washer |
| 6. Cap screw | 18. Coupling spacer | 29. O-ring |
| 7. Wire standoff | 19. Cap screw | 30. Hose clamp |
| 8. Suction hose | 20. Set screw | 31. O-ring |
| 9. Hydrostat | 21. Engine hub | 32. O-ring |
| 10. Push on hose fitting | 22. Square key | 33. Cable tie |
| 11. Hydraulic hose | 23. Rubber coupling | 34. Hydraulic hose |
| 12. 90° hydraulic fitting | | |

Removal (Fig. 31)

- Before removing any parts from the hydraulic system, park machine on a level surface, set brake, lower attachment, and stop engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

- Pivot seat up. Remove cover from the midsection of the machine.



CAUTION

The muffler and exhaust pipe may be hot. Avoid possible burns. Allow engine and exhaust system to cool before working near the muffler.

- Remove muffler shield from the engine by first removing three cap screws and lock washers securing the shield.
- Remove cotter pin and flat washer securing the pump control rod to the pump lever. Pull control rod from the pump lever (Fig. 32).
- Label electrical wires. Disconnect wires from the neutral switch (Fig. 32).
- Remove cap screw and lock nut securing the pump lever to the hydrostat trunnion (Fig. 32).

7. Remove three cap screws securing the pump plate to the hydrostat while pulling the pump plate from the hydrostat (Fig. 32).
8. Clean all hydraulic fittings and hydraulic hoses attached to the hydrostat. Label all hydraulic connections for reassembly.
9. Place a suitable container under hydrostat to collect hydraulic oil.
10. Clamp suction hose (8) to prevent draining the hydraulic tank.
11. Remove hydraulic hoses (11 and 14) from 90° hydraulic fittings (13 and 12). Allow fluid to drain from the hoses into the container.
12. Remove suction hose (8) from push on fitting (10). Allow fluid to drain from the hose into the container.
13. Remove hydraulic hoses (4 and 5) and O-rings (29) from the hydrostat. Allow fluid to drain from the hoses into the container.
14. Put caps or plugs on disconnected hoses and fittings to prevent contamination.
15. Loosen both set screws (20) from hydrostat shaft.
16. Support hydrostat to prevent dropping during removal. Remove both hex nuts (27), lock washers (28), cap screws (6) from the hydrostat (9) and pump mount (25). Pull hydrostat from mount and machine.
17. Remove woodruff key (26) from hydrostat shaft.
18. Match mark position of hydraulic fittings on the hydrostat. Remove remaining fittings (10, 12, and 13) and O-rings (31 and 32) from the hydrostat. Insert caps or plugs into open ports of the hydrostat.

Installation (Fig. 31)

1. Make sure lift valve, hydraulic hoses, fittings, and tubes are cleaned thoroughly.
2. Reinstall O-rings (32) and hydraulic fittings (12 and 13) to the hydrostat. Observe match marks when tightening.
3. Remove caps or plugs from the hydrostat.
4. Install woodruff key (26) to hydrostat shaft. Support hydrostat (9) while positioning onto pump mount (25). Make sure woodruff key (26) stays in place when the shaft is inserted into the pump hub (24).
5. Secure hydrostat to mount with both cap screws (6), lock washers (28), hex nuts (27). Tighten set screw (20) to hydrostat shaft.

6. Remove caps and plugs from disconnected hoses and fittings.
7. Reinstall hydraulic hoses (11 and 14) to 90° hydraulic fittings (13 and 12).
8. Reinstall hose clamp (30) and suction hose (8) to push on fitting (10). Tighten hose clamp.
9. Remove clamp used to prevent draining the hydraulic tank from suction hose (8).
10. Reinstall hydraulic hoses (4 and 5) and O-rings (29) to hydrostat (9).
11. Secure pump plate to the hydrostat with three cap screws. Tighten cap screws while attaching the pump plate to the hydrostat (Fig. 32).
12. Align pump lever to the hydrostat trunnion. Secure pump lever to the hydrostat trunnion with cap screw and lock nut (Fig. 32).
13. Reconnect wires to the neutral switch (Fig. 32).
14. Insert control rod into the pump lever. Secure pump control rod to the pump lever with flat washer and cotter pin (Fig. 32).
15. Secure muffler shield to the engine with three cap screws and lock star washers securing. Make sure R-clamp and fuel hose a secured to the muffler shield by cap screw and lock star washer.
16. Secure cover to the midsection of the machine and pivot seat down.
17. Charge hydraulic system (see Charge Hydraulic System).

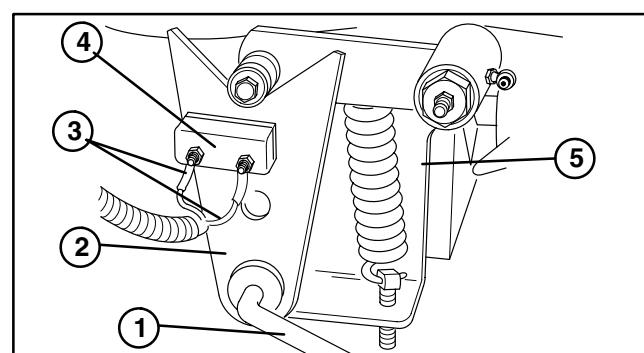


Figure 32

- | | |
|----------------|-------------------|
| 1. Control rod | 4. Neutral switch |
| 2. Pump lever | 5. Pump plate |
| 3. Wires | |

Hydrostat (SP 5020)

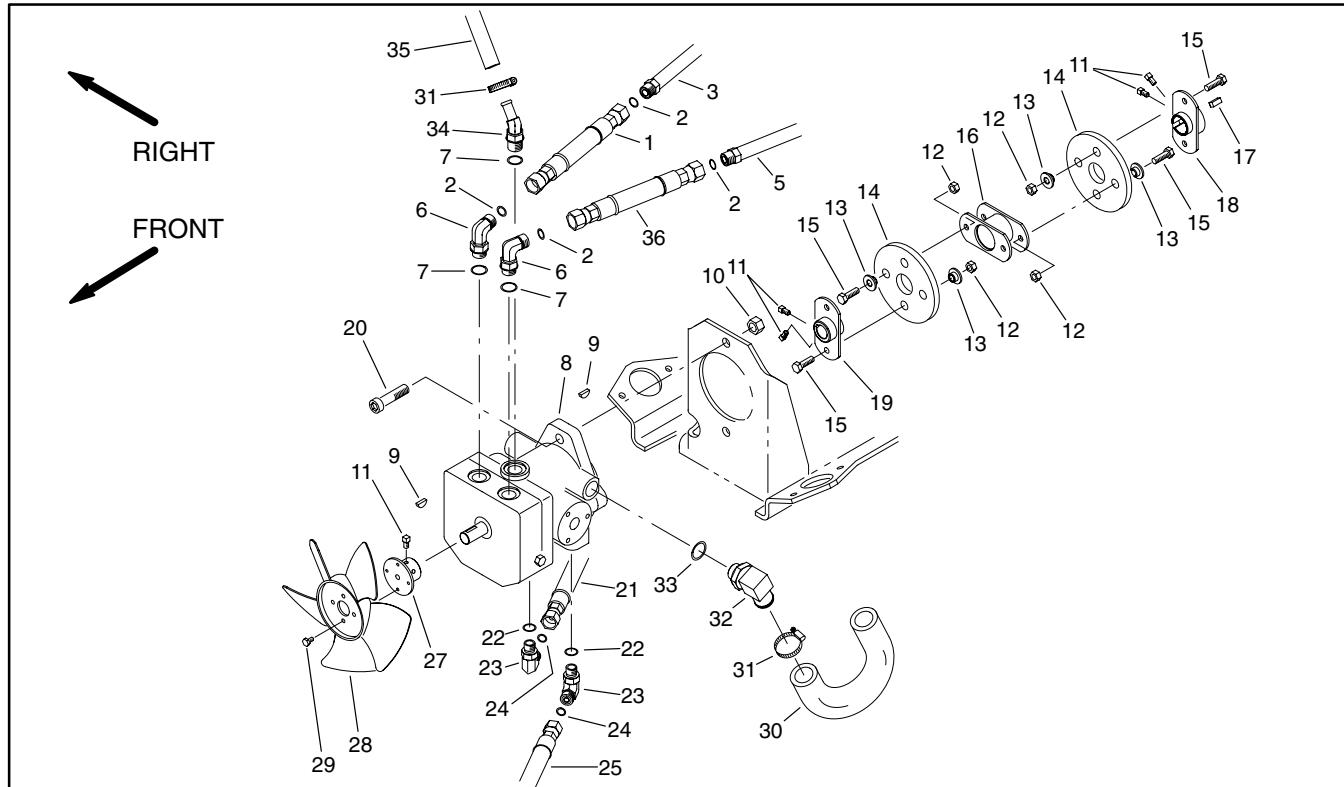


Figure 33

- | | | |
|------------------------------------|------------------------------------|---------------------------------------|
| 1. Hydraulic hose (to front motor) | 13. Coupler spacer | 25. Hydraulic hose (from oil cooler) |
| 2. O-ring | 14. Rubber coupler | 26. Not used |
| 3. Hydraulic tube | 15. Cap screw | 27. Fan hub |
| 4. Not used | 16. Coupling | 28. Cooling fan |
| 5. Hydraulic tube | 17. Square key | 29. Cap screw |
| 6. 90° hydraulic fitting | 18. Engine hub | 30. Hydraulic hose (from oil filter) |
| 7. O-ring | 19. Pump hub | 31. Hose clamp |
| 8. Hydrostat | 20. Socket head screw | 32. 90° hydraulic fitting |
| 9. Woodruff key | 21. Hydraulic hose (To lift valve) | 33. O-ring |
| 10. Lock nut | 22. O-ring | 34. 45° hydraulic fitting |
| 11. Set screw | 23. 90° hydraulic fitting | 35. Hydraulic hose (to tank) |
| 12. Hex nut | 24. O-ring | 36. Hydraulic hose (from rear motors) |

Removal (Fig. 33)

- Before removing any parts from the hydraulic system, park machine on a level surface, set brake, lower attachment, and stop engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

- Pivot seat up. Remove left and right side panels from the machine. Remove left fender and seat (see Left Fender (Seat Base) Removal in Chapter 6 – Wheels, Brakes, and Miscellaneous).



CAUTION

The muffler and exhaust pipe may be hot. To avoid possible burns, allow engine and exhaust system to cool before working near the muffler.

- Disconnect wire harness as follows: disconnect blue wire from magneto terminal, disconnect blue wire from voltage regulator, disconnect red/white wire from fuel solenoid (Fig. 45).
- Disconnect red positive cable cable (solenoid) from the starter. Remove lock nut and cap screw securing black ground wire and black battery cable (negative) to the engine block. Pull cable and harness clear of the engine (Fig. 47).

5. Disconnect air hose from the air cleaner. Remove lower shroud from the cooler mount to prevent damage to the fan when removing the hydrostat.
6. Disconnect control rod from pump lever and wires from the neutral switch (Fig. 36).
7. Loosen both set screws (11) on the pump hub (19) enough to allow the hydrostat shaft to be released.
8. Clamp hydraulic hose (35) and hydraulic hose (25) to prevent draining of the tank. Disconnect all six hydraulic hoses from fittings on the hydrostat. Allow hoses to drain into a suitable container.
9. Remove self tapping screw securing R-clamp and fuel hose to the frame (Fig. 37)



CAUTION

One person should operate the chain fall or hoist while the other person guides the engine from the frame.

IMPORTANT: When moving the engine and hydrostat from the frame, make sure not to damage the cooling fan, wires, hoses, and cables.

10. Reposition hydrostat and engine as follows:
 - A. Position a jack or chain fall to the engine base (Fig. 39).
 - B. Remove lock nuts, flat washers, and cap screws securing both **front** engine mounts to the frame (Fig. 38).
 - C. Remove cap screws and flat washers securing the engine support to the frame (Fig. 39).
 - D. Lower and pull back hydrostat and engine from the cooler mount so the cooling fan is clear of the mount.
11. Separate hydrostat from the engine base by removing both lock nuts and socket head screws.
12. Remove fan hub (27) with cooling fan (28) and woodruff key (9) from the hydrostat shaft.
13. Match mark position of all hydraulic fittings on the hydrostat. Remove all hydraulic fittings and O-rings from the hydrostat. Plug or cap all ports to prevent contamination.
14. Remove cap screw and lock nut securing the pump lever to the hydrostat trunnion. Remove three cap screws securing the pump plate to the hydrostat while pulling the pump plate from the hydrostat (Fig. 36).

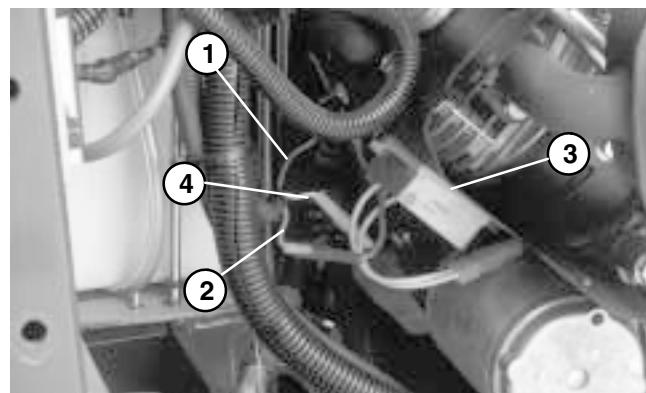


Figure 34
 1. Blue wire (magneto) 3. Voltage regulator
 2. Blue wire (voltage reg.) 4. Red/white wire

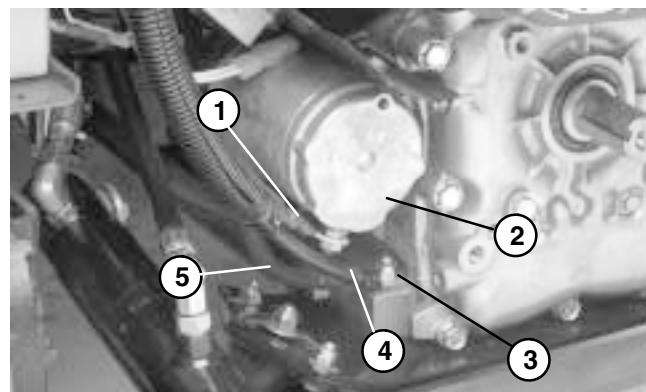


Figure 35
 1. Positive cable (solenoid) 4. Battery cable (negative)
 2. Starter 5. Ground wire (frame)
 3. Lock nut and cap screw

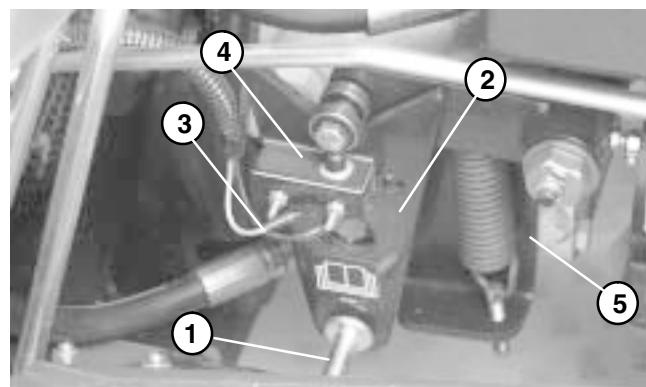


Figure 36
 1. Control rod 4. Neutral switch
 2. Pump lever 5. Pump plate
 3. Wires

Installation (Fig. 33)

1. Make sure hydraulic hoses, fittings, and tubes are cleaned thoroughly.
2. Securing pump plate to the hydrostat with three cap screws. Secure pump lever to the hydrostat trunnion with cap screw and lock nut (Fig. 36).

3. Reinstall O-rings and hydraulic fittings to the hydrostat. Observe match marks when tightening.
4. Install woodruff key (9) and fan hub (27) with cooling fan (28) to the hydrostat shaft. Secure hub to shaft with both set screws.
5. Secure hydrostat (8) to engine base with both socket head screws (20) and lock nuts (10).
6. Reinstall engine and hydrostat as follows:



CAUTION

One person should operate the chain fall or jack while the other person guides the engine to the frame.

IMPORTANT: When repositioning the engine and hydrostat to the frame, make sure not to damage the cooling fan, wires, hoses, and cables.

- A. Use jack or chain fall to position the front engine mounts and engine support to the frame (Fig. 38 and 39).
- B. Secure engine mount to the frame with four cap screws and flat washers (Fig. 39).
- C. Secure front engine mounts to the frame with both cap screws, flat washers, and lock nuts (Fig. 38).
- D. Remove jack or chain fall from the engine base.
7. Secure R-clamp and fuel hose to the frame with self tapping screw (Fig. 37).
8. Connect all six hydraulic hoses to fittings on the hydrostat. Remove clamps from hydraulic hoses (25 and 35) that prevented draining of the tank.
9. Tighten both set screws (11) on pump hub (19) enough to secure the hub to the shaft.
10. Connect air hose to the air cleaner. Install lower shroud to the cooler mount. Connect control rod to the pump lever (Fig. 36).
11. Secure black ground wire and black battery cable (negative) to the engine block with cap screw and lock nut (Fig. 47).
12. Connect red positive cable (solenoid) to the starter (Fig. 47).
13. Connect wire harness as follows: connect blue wire to the magneto terminal, connect blue wire to the voltage regulator, and connect red/white wire to the fuel solenoid (Fig. 45).

14. Install left fender and seat (see Left Fender (Seat Base) Installation in Chapter 6 – Wheels, Brakes, and Miscellaneous). Install left and right side panels to the machine. Lower seat.

15. Charge hydraulic system (see Charge Hydraulic System).

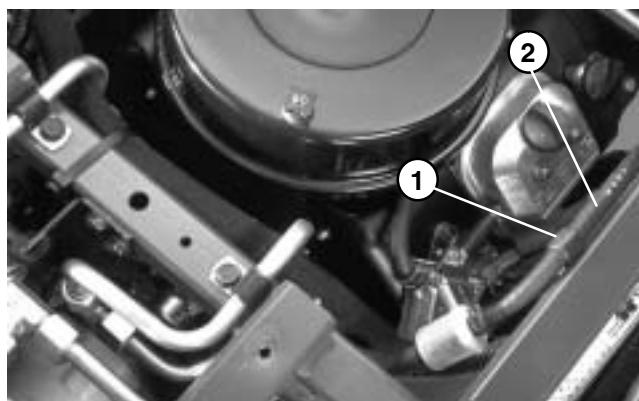


Figure 37

1. R-clamp

2. Fuel hose

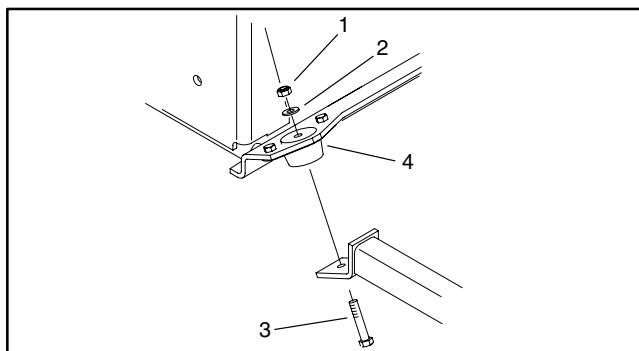


Figure 38

1. Lock nut
2. Flat washer

3. Cap screw
4. Engine mount

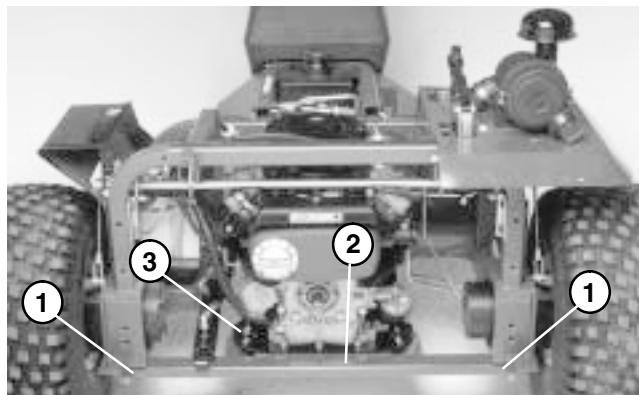


Figure 39

1. Cap screw & flat washer 3. Engine base
2. Engine support

Flush Hydraulic System

IMPORTANT: Flush hydraulic system any time there is a severe component failure or the system is contaminated (oil appears milky or black or contains metal particles).

IMPORTANT: Flush hydraulic system when changing from petroleum base hydraulic fluid. Operate machine under normal operating conditions for at least four (4) hours before draining.

1. Park machine on a level surface. Lower attachments, stop engine, and engage parking.



IMPORTANT: Make sure to clean around any hydraulic connections that will be disconnected for draining.

2. Drain hydraulic tank (see Hydraulic Tank Removal).
3. Make sure lift cylinder, lift valve, hydrostat, oil cooler, wheel motors, hoses, and tube lines are drained into a suitable container while the system is warm.
4. Remove oil filter and drain into a suitable container. Discard filter (see Change Hydraulic System Fluid and Filter).
5. Inspect and clean tank (see Hydraulic Tank Inspection).
6. Install new oil filter and drain into a suitable container. Discard filter (see Change Hydraulic System Fluid and Filter).

NOTE: Use only hydraulic fluids (including biodegradable) specified in Checking Hydraulic System Fluid. Other fluids may cause system damage.

7. Reconnect all hydraulic hoses, lines, and components that were disconnected prior to draining.
8. Fill hydraulic tank with new hydraulic fluid (see Change Hydraulic System Fluid and Filter).
9. Disconnect both spark plug leads from spark plugs.
10. Turn ignition key switch; engage starter for 10 seconds to the prime hydrostat. Repeat this step again.

11. Connect both spark plug leads to spark plugs.
12. Start engine and let it idle at low speed (**1750 ± 50 RPM**) for a minimum 2 minutes. Increase engine speed to high idle (**3150 ± 50 RPM**) for minimum of 1 minute under no load.
13. Raise and lower attachments several times.
14. Shut off engine and check for hydraulic oil leaks. Check oil level in hydraulic tank and add correct oil if necessary.
15. Operate the machine for 2 hours under normal operating conditions.
16. Check condition of hydraulic oil. If the new fluid shows any signs of contamination, or if you are changing to biodegradable fluid, repeat steps 1 through 16 again.
17. Assume normal operation and follow recommended maintenance intervals.

Hydrostat Service

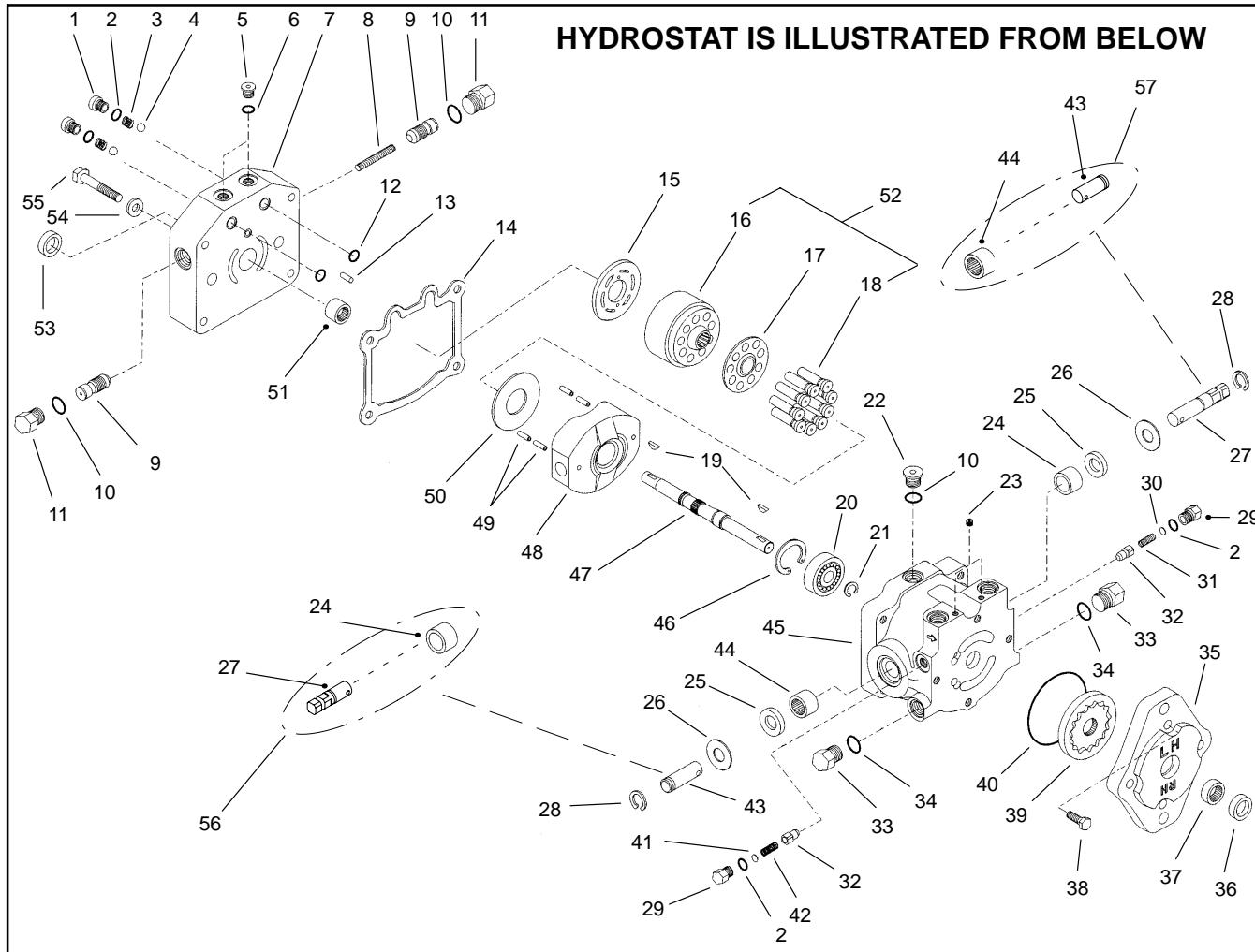


Figure 40

- | | | |
|------------------------------|----------------------------------|--------------------------------------|
| 1. Plug | 20. Ball bearing | 39. Gerotor assembly |
| 2. O-ring | 21. Retaining ring | 40. O-ring |
| 3. Spring | 22. Plug | 41. Charge relief shim kit |
| 4. Ball | 23. Pipe plug (2 used) | 42. Charge relief spring |
| 5. Plug | 24. Journal bearing | 43. Trunnion shaft (SP 2020/3020) |
| 6. O-ring | 25. Lip seal | 44. Needle bearing |
| 7. End cap | 26. Washer | 45. Variable housing |
| 8. Acceleration valve spring | 27. Control shaft (SP 2020/3020) | 46. Retaining ring |
| 9. Acceleration valve | 28. Retaining ring | 47. Shaft |
| 10. O-ring | 29. Plug | 48. Swashplate |
| 11. Plug | 30. Implement relief shim kit | 49. Spring pin |
| 12. O-ring | 31. Implement relief spring | 50. Thrust plate |
| 13. Locating pin | 32. Poppet | 51. Shaft bearing |
| 14. End cap gasket | 33. Plug | 52. Cylinder block assembly |
| 15. Valve plate | 34. O-ring | 53. Lip seal |
| 16. Cylinder block | 35. Charge pump housing | 54. Washer (4 used) |
| 17. Spider | 36. Lip seal | 55. Cap screw (4 used) |
| 18. Piston assembly | 37. Needle bearing | 56. Control shaft/bearing (SP 5020) |
| 19. Woodruff key | 38. Cap screw (4 used) | 57. Trunnion shaft/bearing (SP 5020) |

Note: The hydrostat used on the Sand Pro 2020, 3020, and 5020 are very similar. Due to different pump attachment to the engine, the location of the control shaft is different. On the Sand Pro 2020 and 3020, the control shaft is on the implement relief valve (30 and 31) side of the hydrostat. On the Sand Pro 5020, the control shaft is on the charge relief valve (41 and 42) side.

Charge Pump Disassembly

1. Make sure hydrostat is cleaned thoroughly before disassembly to prevent contamination.
2. Match mark charge pump housing and variable housing for reassembly.
3. Clean shaft to remove all sharp edges, burrs, dirt, and abrasive residue that could damage the lip seal.
4. Remove both cap screws securing the pump housing to the variable housing.
5. Slide charge pump housing with needle bearing and lip seal carefully off the shaft. Slide gerotor assembly off the shaft.
6. Remove O-ring from the charge pump housing and discard.

Charge Pump Inspection

1. Inspect wear surfaces of inner and outer gear of the gerotor assembly for excessive scratching and heavy wear patterns. Replace entire gerotor assembly if either part needs replacing.
2. Inspect needle bearing for visible signs of wear. Replace bearing if needles do not turn freely or do not remain in cage. Replace bearing as necessary.
3. Inspect lip seal for tears and damage that will reduce the sealing properties of the seal. Replace as necessary.
4. Inspect gerotor pocket inside the charge pump housing of excessive scoring. Replace as necessary.

Charge Pump Assembly

1. Coat both sides of gerotor assembly and pump housing face with clean hydraulic oil.
2. Slide gerotor assembly onto the shaft. Make sure inner gear splines mesh with the splines on the shaft.
3. Coat O-ring with clean hydraulic oil and place into charge pump housing.
4. Coat shaft with clean hydraulic oil. Slide charge pump housing onto shaft being careful not to damage lip seal.
5. Align match marks. Secure charge pump housing to variable housing with both cap screws.

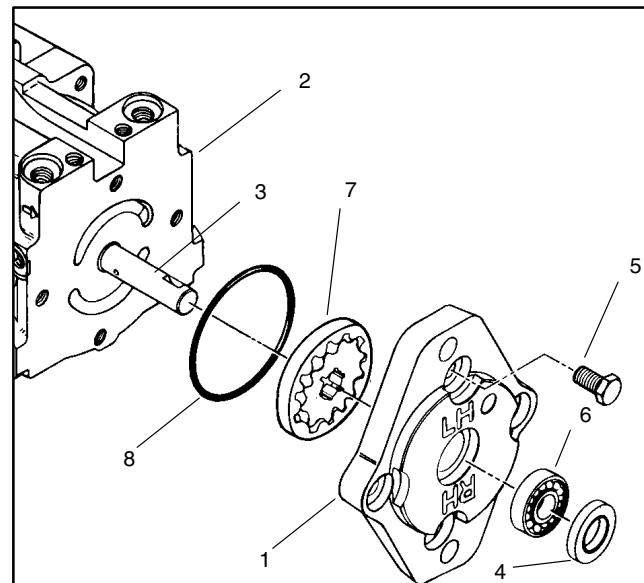


Figure 41

- | | |
|------------------------|-----------------------|
| 1. Charge pump housing | 5. Cap screw (4 used) |
| 2. Variable housing | 6. Needle bearing |
| 3. Shaft | 7. Gerotor assembly |
| 4. Lip seal | 8. O-ring |

Shaft Seal Removal

NOTE: The hydrostat uses lip seals on the main, control, and trunnion shafts. Replacement of these seals requires no disassembly.

1. When replacing trunnion shaft seals, remove retaining ring and washer from the housing and shaft.
2. Pry lip seal carefully off the shaft. Make sure not to distort the housing or damage the bore or shaft. Discard seal.

Shaft Seal Installation

1. Polish exposed surface of the shaft. Remove all sharp edges, burrs, dirt, and abrasive residue that could damage the lip seal during installation.

NOTE: The outside diameter of the lip seal may be coated with Loctite High Performance Sealant 5923 or equivalent. This aids the prevention of leaks caused by seal bore damage.

2. Lubricate shaft with clean hydraulic oil. Slide lip seal over shaft carefully. Make sure not to damage lip seal. Press seal into housing bore.
3. Replace washer if it is noticeably bent or distorted.
4. After replacing trunnion shaft seals, reinstall washer and retaining ring to the shaft and housing.

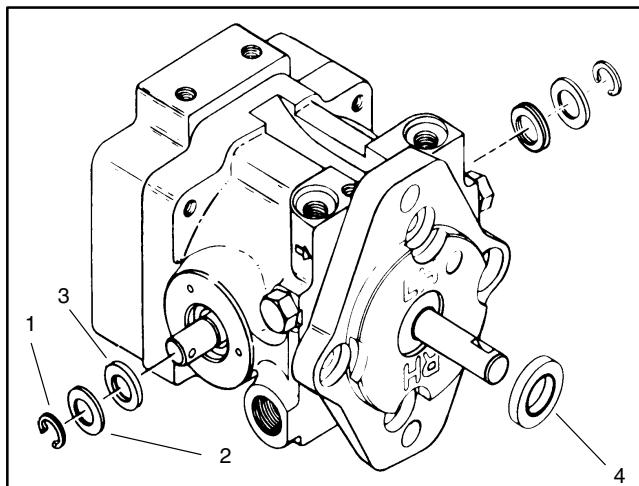


Figure 42

- | | |
|-------------------|-------------|
| 1. Retaining ring | 3. Lip seal |
| 2. Washer | 4. Lip seal |

Acceleration Valve Removal (Fig. 43)

1. Remove plugs and O-rings from both sides of the end cap.
2. Slide acceleration valve and spring out of one side of the end cap. Slide other valve out the other side.

Acceleration Valve Inspection (Fig. 43)

1. Inspect valves for cracks, bending, and plugged holes. Clean out plugged holes; be careful not to damage the valve. Replace valve as necessary.
2. Inspect valve bores in the end cap for damage and foreign material. Remove any foreign material.

Acceleration Valve Assembly (Fig. 43)

1. Insert valve into valve bore. Insert spring and other valve into other bore.
2. Install O-rings and plugs into both sides of the end cap. Tighten plugs.

Relief Valve Disassembly (Fig. 44)

Note: On the Sand Pro 2020 and 3020 the control shaft is on the implement relief valve side of the hydrosstat. On the Sand Pro 5020, the control shaft is on the charge relief valve side.

1. Remove plug and O-ring from variable housing.

IMPORTANT: Do not alter shims or interchange parts between relief valves.

2. Slide shim kit, spring, and poppet out of the housing.

Relief Valve Inspection (Fig. 44)

1. Inspect poppet and spring for nicks, cracks, and distortion. Replace parts as necessary.
2. Inspect valve seat in the housing for damage and foreign material. Remove any foreign material.

Relief Valve Assembly (Fig. 44)

1. Insert poppet, spring, and shim kit into housing.
2. Install O-rings and plugs into housing. Tighten plugs.

Charge Check Valve Disassembly (Fig. 44)

1. Remove plug and O-ring from variable housing end cap.
2. Slide spring and ball out of the end cap.

Charge Check Valve Inspection (Fig. 44)

1. Inspect ball and spring for nicks, cracks, and distortion. Replace parts as necessary.
2. Inspect valve seat in the end cap for damage and foreign material. Remove any foreign material.

Charge Check Valve Assembly (Fig. 44)

1. Insert ball and spring into the end cap.
2. Install O-rings and plugs into end cap. Tighten plugs.

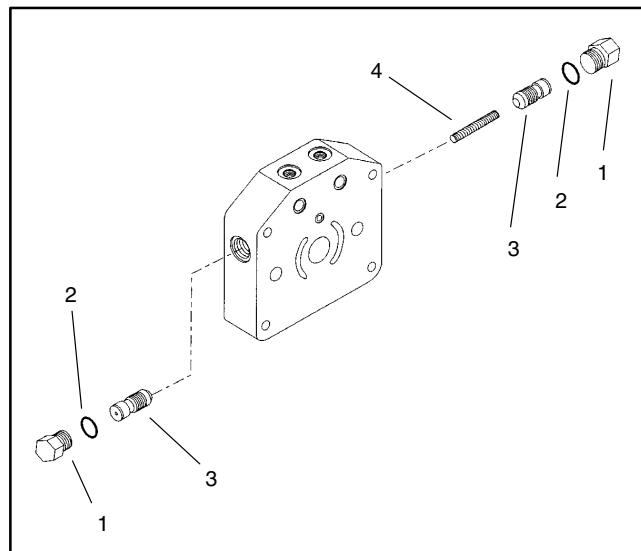


Figure 43

1. Plug
2. O-ring
3. Acceleration valve
4. Spring

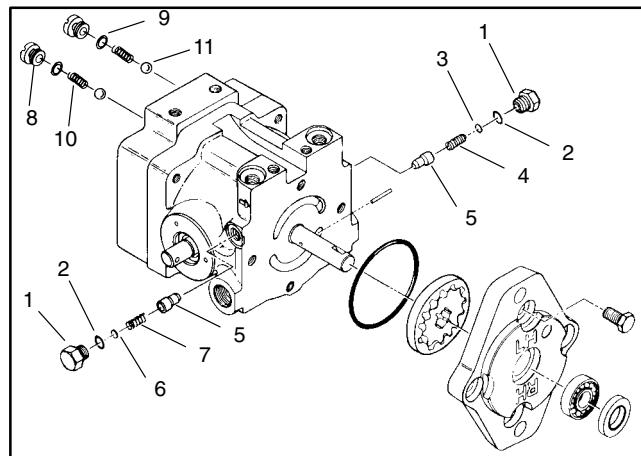


Figure 44

1. Plug
2. O-ring
3. Shim kit (implement)
4. Spring (implement)
5. Poppet
6. Shim kit (charge)
7. Spring (charge)
8. Plug
9. O-ring
10. Spring (charge check)
11. Ball (charge check)

Traction Pump Disassembly

1. Remove charge pump from variable housing (see Charge Pump Disassembly).
2. Remove lip seals from shaft and trunnion shafts (see Shaft Seal Removal).

IMPORTANT: All exposed surfaces are critical. Use caution to avoid damage to exposed surfaces.

3. Remove four cap screws and washers from the end cap. Loosen cap screws evenly to prevent distortion of parts (Fig. 45).

A. Internal spring loading should cause the end cap to separate slightly from the variable housing. If separation does not occur during loosening, tap end cap with a soft hammer until parts separate.

B. Make sure valve plate does not fall and become damaged. Discard O-rings and end cap gasket.

4. Remove end cap and valve plate together from the variable housing. If valve plate remains on the cylinder block, remove it. Remove locating pin from the end cap (Fig. 45).

NOTE: The pistons may slide out of the cylinder block. Piston placement in the bores requires no special orientating. Do not disassemble spring or other parts from the center bore of the cylinder block.

5. Remove cylinder block assembly from the variable housing. Remove thrust plate from the counterbore in the face of the swashplate (Fig. 46).

IMPORTANT: Make sure not to damage the face surface on the cavity side of the variable housing.

6. Position variable housing so the large cavity faces up (Fig. 47).

NOTE: The variable housing has a cast recess that allows the spring pins to be driven free of the trunnion shaft and control shaft.

7. Drive spring pin out of the trunnion shaft and control shaft using a 3/16 inch diameter drift punch (Fig. 47).

8. Drive control and trunnion shafts outward and out of the swashplate bore. Shafts remove easily once clear of the swashplate bore (Fig. 47).

9. Remove swashplate from the variable housing. Remove retaining ring from the variable housing. Press shaft out with bearing and retaining ring. Remove retaining ring and bearing from the shaft (Fig. 47).

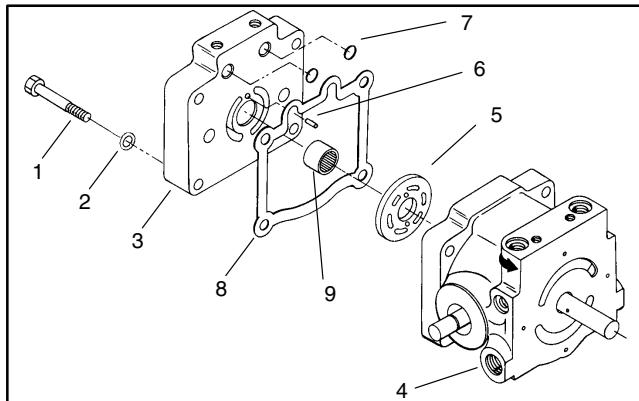


Figure 45

- | | |
|---------------------|-------------------|
| 1. Cap screw | 6. Locating pin |
| 2. Washer | 7. O-rings |
| 3. End cap | 8. End cap gasket |
| 4. Variable housing | 9. Needle bearing |
| 5. Valve plate | |

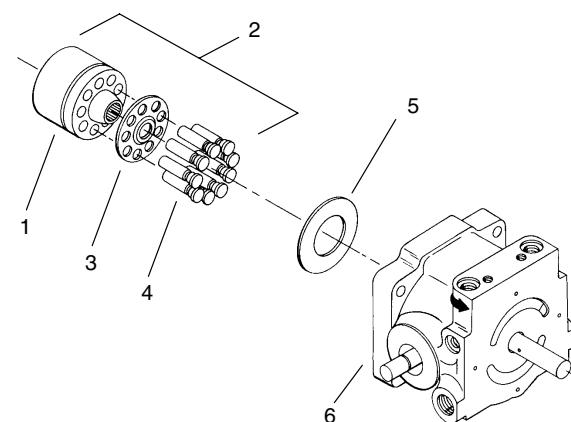


Figure 46

- | | |
|----------------------------|----------------------|
| 1. Cylinder block | 4. Piston assemblies |
| 2. Cylinder block assembly | 5. Thrust plate |
| 3. Spider | 6. Variable housing |

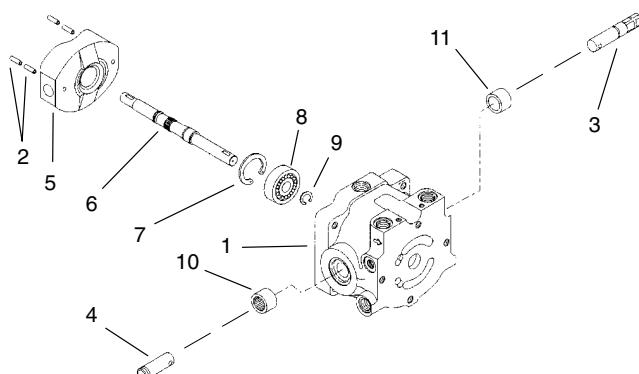


Figure 47

- | | |
|---------------------|---------------------|
| 1. Variable housing | 7. Retaining ring |
| 2. Spring pins | 8. Ball bearing |
| 3. Control shaft | 9. Retaining ring |
| 4. Trunnion shaft | 10. Needle bearing |
| 5. Swashplate | 11. Journal bearing |
| 6. Shaft | |

Traction Pump Inspection

1. Inspect end cap (Fig. 45).

A. Bearing needles must remain in the cage, roll freely, and not be bent or damaged. Remove and replace bearings as necessary.

B. Journal bearing must be free of damage.

C. Needle and journal bearings should protrude beyond face from 3/32 to 1/8 inch (2.38 to 3.18 mm).

2. Inspect valve plate. There should be no signs of scoring on contact surfaces (Fig. 45).

NOTE: The pistons may slide out of the cylinder block. Piston placement in the bores requires no special orientating. Do not disassemble spring or other parts from the center bore of the cylinder block.

3. Inspect cylinder block assembly. (Fig. 48).

A. Verify that piston O.D. finish shows no wear or deep scratches. Piston shoes should fit snuggly onto the ball end of the pistons. The shoe surface that contacts the thrust plate should be smooth and flat. **Do not lap piston shoes.**

B. The cylinder block surface that makes contact with the valve plate should be smooth and free of deep scratches. **Do not lap cylinder block.**

C. The bore areas of the cylinder block should be free of scoring and contamination. Pistons should move freely in the bore areas.

D. Examine the mutual contact surfaces on the spider and spider pivot; both contact areas should be smooth and free of wear.

E. Replace entire cylinder block assembly if any components are damaged.

4. Inspect thrust plate. There should be no signs of scoring on the piston shoe contact surfaces (Fig. 47).

5. Inspect variable housing (Fig. 47).

A. Bearing needles must remain in the cage, roll freely, and not be bent or damaged. Remove and replace bearings as necessary

B. Needle bearings should be flush to 1/64 inch (0.40 mm) below the counter bore for the lip seals.

C. The face surface that contacts with the gerotor assembly should be free of excessive scoring.

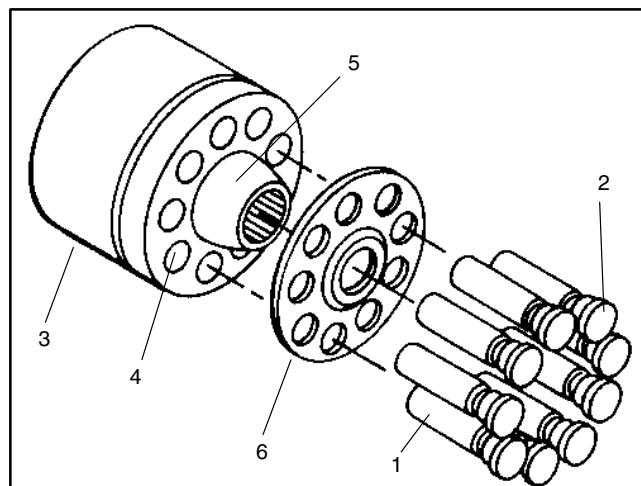


Figure 48

- 1. Piston assembly
- 2. Piston shoe
- 3. Cylinder block

- 4. Cylinder block bore
- 5. Spider pivot
- 6. Spider

Traction Pump Assembly

1. Make sure all parts are cleaned thoroughly and free of dirt and debris.
2. Secure ball bearing onto shaft with retaining ring. Press assembly into variable housing. Snap retaining ring into housing to secure bearing and shaft (Fig. 49).
- IMPORTANT: Make sure not to damage the face surface on the cavity side of the variable housing.**
3. Position variable housing so the large cavity is up. Press needle bearings into each side of the variable housing. Make sure bearings are flush to 1/64 inch (0.40 mm) below the counter bore for the lip seals (Fig. 49).
4. Place swashplate into variable housing with the counter bore for the thrust plate facing up (Fig. 49).
5. Make sure control shaft is positioned to the proper side of the variable housing before installing. The control shaft should be installed on the side of the pump that will accept the pump control linkage (Fig. 49).

- A. Insert control and trunnion shafts through the housing into the swash plate bores.
- B. Make sure holes in the swashplate and shafts are aligned properly.
- 6. Insert **new** spring pins through the swashplate and into the control and trunnion shafts (Fig. 50).
 - A. Install first pin until the second pin can be started.
 - B. Drive both pins in until the last pin is 1/4 inch (6.35 mm) below the swash plate.
 - C. Repeat steps A and B on the other shaft.
 - D. Make sure swashplate swings freely and to 15° each way from the center position.
- 7. Lubricate thrust plate with clean hydraulic fluid. Make sure contact surface for the piston shoes is facing up (Fig. 51).

NOTE: Piston placement in the bores requires no special orientating.

8. Lubricate cylinder block, spider, and piston assemblies with clean hydraulic oil. Insert piston assemblies through the spider and into the bores. Make sure spider and spider pivot contact surfaces align properly (Fig. 51).

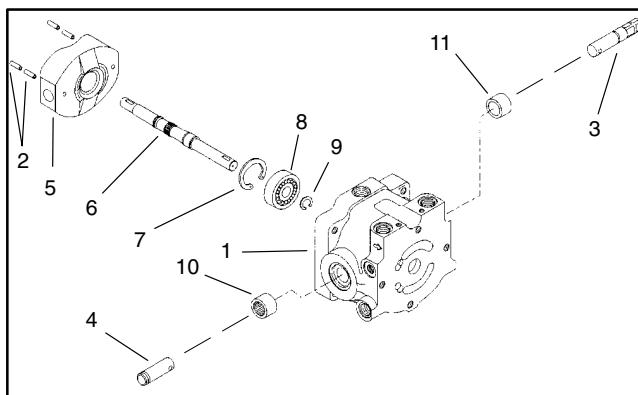


Figure 49

- | | |
|---------------------|---------------------|
| 1. Variable housing | 7. Retaining ring |
| 2. Spring pins | 8. Ball bearing |
| 3. Control shaft | 9. Retaining ring |
| 4. Trunnion shaft | 10. Needle bearing |
| 5. Swashplate | 11. Journal bearing |
| 6. Shaft | |

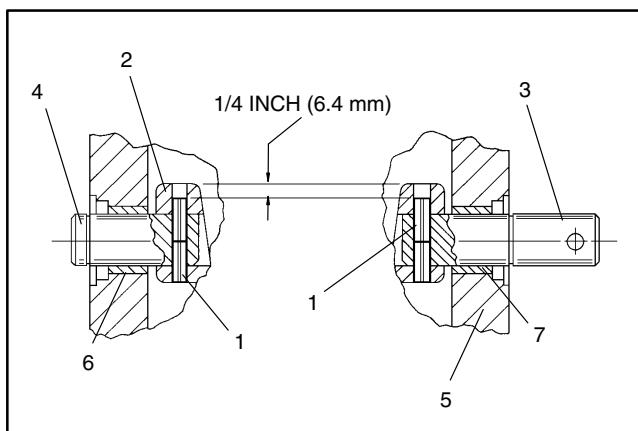


Figure 50

- | | |
|-------------------|---------------------|
| 1. Spring pin | 5. Variable housing |
| 2. Swashplate | 6. Needle bearing |
| 3. Control shaft | 7. Journal bearing |
| 4. Trunnion shaft | |

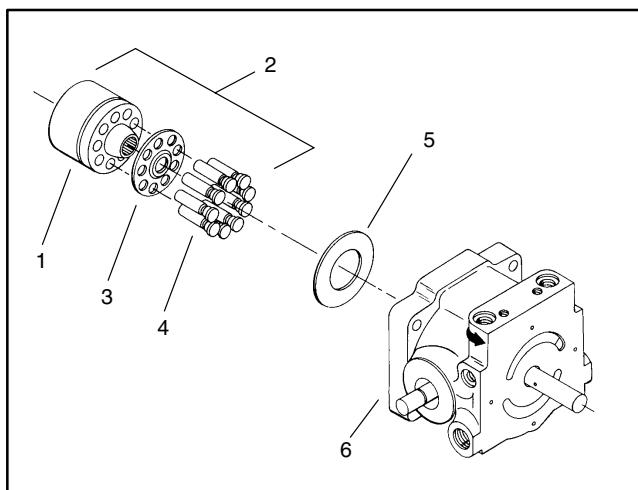


Figure 51

- | | |
|----------------------------|----------------------|
| 1. Cylinder block | 4. Piston assemblies |
| 2. Cylinder block assembly | 5. Thrust plate |
| 3. Spider | 6. Variable housing |

NOTE: When properly installed, a light spring compression can be felt when pushing the cylinder block assembly into the variable housing.

9. Position variable housing in a horizontal position. Slide cylinder block assembly over the shaft engaging splines. Make sure pistons and thrust plate remain in place (Fig. 51).

10. Press needle bearing into the end cap. Bearing must protrude 3/32 to 1/8 inch (2.38 to 3.18mm) from face (Fig. 51).

11. Lubricate exposed face of the cylinder block with clean hydraulic fluid (Fig. 51).

12. Position end cap to the variable housing. Lubricate O-rings with clean hydraulic fluid. Position O-rings into recessed holes of the end cap (Fig. 52).

13. Slide four cap screws through washers and end cap holes. Place gasket onto the cap screws and the end cap face (Fig. 52).

IMPORTANT: Make sure slotted and grooved side of the valve plate is against the end cap face. The two V-notches must face away from the end cap.

14. Insert locating pin into the end cap. Lubricate slotted side of valve plate. Slip plate over pin and protruding bearing (Fig. 52).

IMPORTANT: Make sure valve plate, gasket, and O-rings stay in position when securing the end cap to the variable housing.

15. Mate four cap screws to the variable housing (Fig. 52).

A. Tighten cap screws in an alternating pattern while checking for proper assembly. Turn pump and control shafts slowly while tightening cap screws.

B. Tighten screws until the housing and end cap are completely pulled together.

C. Torque cap screws from 27 to 37 ft-lb (3.7 to 5.1 kg-m).

16. Assemble charge pump to variable housing (see Charge Pump Assembly).

17. Install new lip seals to shaft and trunnion shafts (see Shaft Seal Installation).

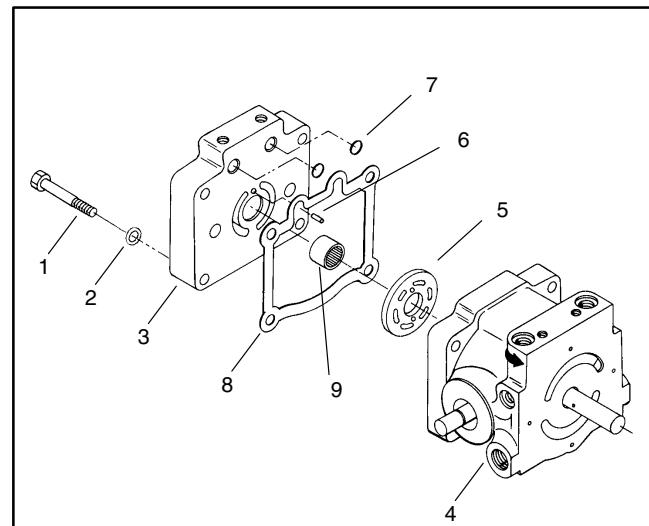


Figure 52

- | | |
|-----------------------|-------------------|
| 1. Cap screw (4 used) | 6. Locating pin |
| 2. Washer (4 used) | 7. O-rings |
| 3. End cap | 8. End cap gasket |
| 4. Variable housing | 9. Needle bearing |
| 5. Valve plate | |

Front Wheel Motor

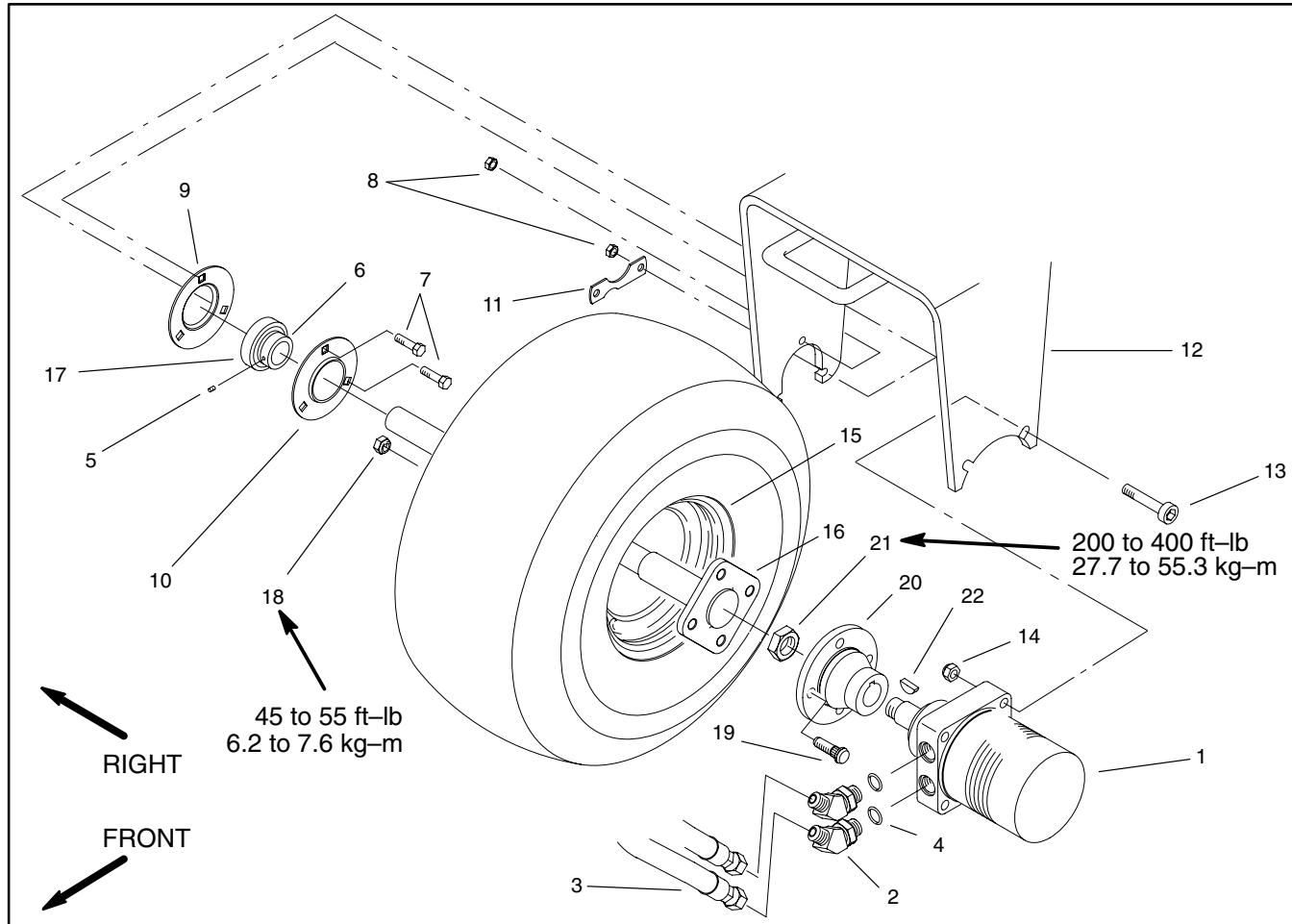


Figure 53

- | | | |
|--------------------------|-----------------------|------------------|
| 1. Hydraulic motor | 9. Relube flange | 16. Spindle |
| 2. 45° hydraulic fitting | 10. Flangette | 17. Bearing |
| 3. Hydraulic hose | 11. Bearing tab | 18. Lug nut |
| 4. O-ring | 12. Front wheel fork | 19. Drive stud |
| 5. Set screw | 13. Socket head screw | 20. Wheel hub |
| 6. Locking collar | 14. Lock nut | 21. Lock nut |
| 7. Cap screw | 15. Front wheel | 22. Woodruff key |
| 8. Lock nut | | |

Removal (Fig. 29)

1. Before removing any parts from the hydraulic system, park the machine on a level surface, engage the parking brake, lower attachment, and stop the engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

2. Clean hydraulic wheel motor, 45° hydraulic fittings, and hydraulic hose connections thoroughly.
3. Label all hydraulic connections for reassembly. Disconnect hydraulic hoses from 45° hydraulic fittings. Allow hoses to drain into a suitable container.
4. Match mark 45° hydraulic fittings and hydraulic wheel motor for reassembly. Remove fittings and O-rings from motor.
5. Put caps or plugs on disconnected hoses and fittings to prevent contamination.
6. Loosen both set screws on the locking collar.
7. Remove three cap screws and lock nuts securing the flangettes and bearing tab to the fork.

8. Remove both socket head screws and lock nuts securing the hydraulic motor the fork.



WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

IMPORTANT: Support wheel and motor when jacking up the front fork to prevent dropping and damaging the motor.

9. Jack up fork slowly until the hydraulic motor and flangettes can be removed from the fork. Remove flangettes, spindle, wheel, and motor from the fork.

10. Slide flangettes and bearing assembly from the spindle. Do not further disassemble flangettes and bearing.

11. Remove four lug nuts from the drive studs. Remove wheel from the drive studs and spindle. Separate spindle from drive studs and wheel hub.

12. Lock wheel hub in a vice. Remove lock nut from the shaft of the hydraulic motor. Pull motor shaft from hub. Remove woodruff key from the motor shaft.

Installation (Fig. 29)

1. Lock wheel hub in a vice. Install woodruff key into the hydraulic motor shaft. Slide motor shaft into hub and secure with lock nut. Torque lock nut from 200 to 400 ft-lb (27.7 to 55.3 kg-m).

2. Install spindle to drive studs and wheel hub. Insert spindle and drive studs through wheel. Make sure valve stem and hydraulic motor are on the opposite sides of the wheel.

3. Secure lug nuts to drive studs. Torque nuts from 45 to 55 ft-lb (6.2 to 7.6 kg-m).

4. Slide flangette and bearing assembly onto the spindle shaft so the locking collar faces the wheel.

5. Position hydraulic motor, wheel, and flangettes to the front fork.

6. Lower front fork slowly making sure flangettes and front wheel motor fit snugly into the fork.

A. Secure flangettes to the fork with cap screws, bearing tab, and locknuts.

B. Secure hydraulic motor to the front fork with socket head screws and lock nuts.

7. Lower fork completely. Make sure flangette and hydraulic motor are positioned correctly into the fork. Tighten fasteners properly.

8. Apply Loctite 242 or equivalent to both set screws. Install set screws to locking collar. Torque set screws from 65 to 80 in-lb (74.9 to 92.2 kg-cm).

9. Remove caps or plugs from disconnected hoses and fittings

10. Install O-rings and 45° hydraulic fittings to the hydraulic motor. Torque fittings from 72 to 80 ft-lb (9.9 to 11 kg-m).

11. Connect hydraulic hoses from 45° hydraulic fittings. torque hose connections from 25 to 30 ft-lb (3.5 to 4.1 kg-m).

12. Charge hydraulic system (see Charge Hydraulic System).

Rear Wheel Motors (SP 2020/3020)

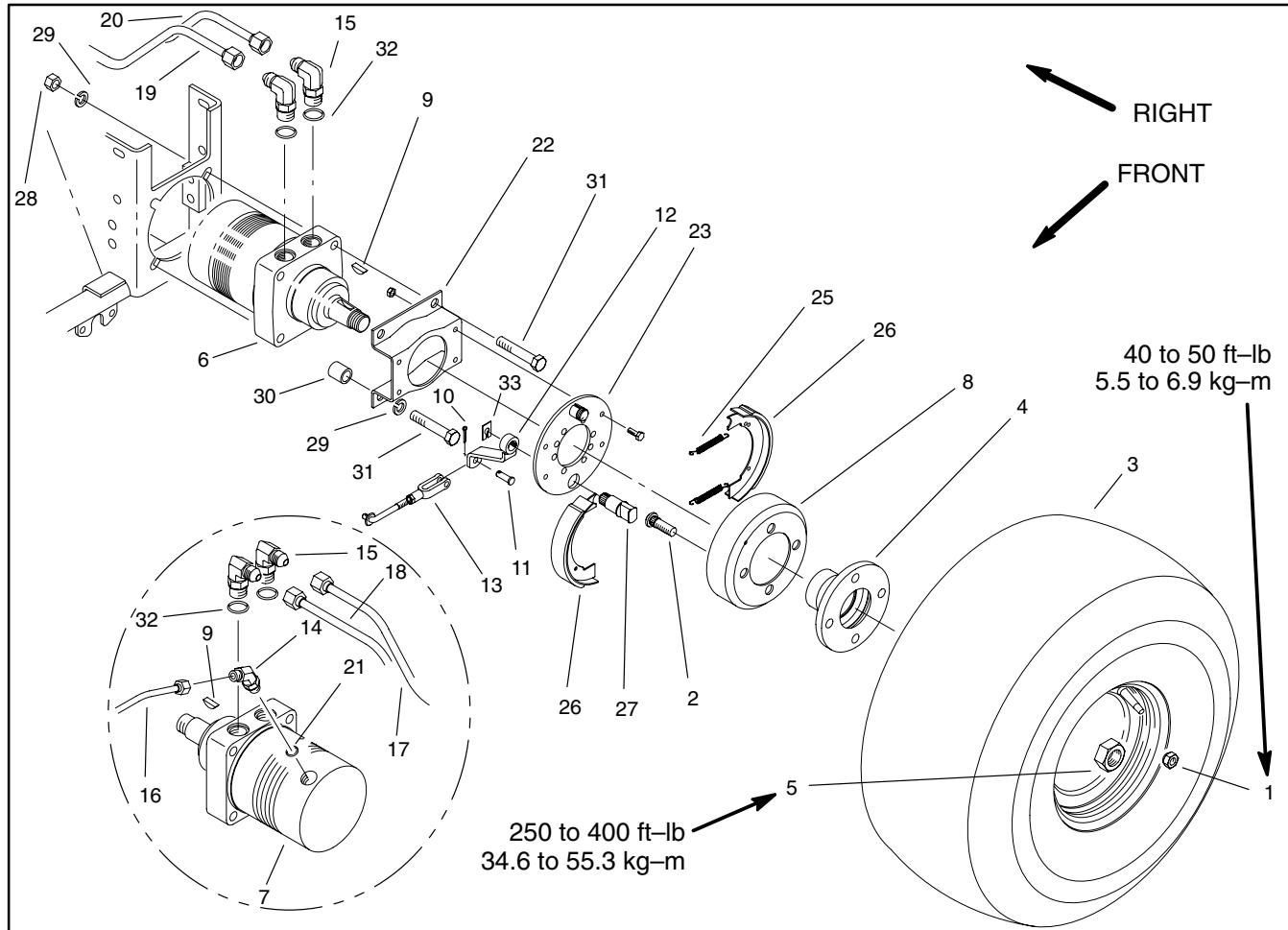


Figure 54

- | | | |
|----------------------|--------------------------------------|--------------------|
| 1. Lug nut | 12. Brake lever | 23. Backing plate |
| 2. Drive stud | 13. Clevis | 24. Anchor pin |
| 3. Wheel | 14. 45° hydraulic fitting | 25. Return spring |
| 4. Wheel hub | 15. 90° hydraulic fitting | 26. Brake shoe |
| 5. Lock nut | 16. Shuttle valve hydraulic tube | 27. Cam shaft |
| 6. Left wheel motor | 17. Right motor rear hydraulic tube | 28. Hex nut |
| 7. Right wheel motor | 18. Right motor front hydraulic tube | 29. Lock washer |
| 8. Brake drum | 19. Left motor front hydraulic tube | 30. Spacer |
| 9. Woodruff key | 20. Left motor rear hydraulic tube | 31. Cap screw |
| 10. Cotter pin | 21. O-ring | 32. O-ring |
| 11. Clevis pin | 22. Brake bracket | 33. Retaining clip |

Removal (Fig. 57 or 55)

1. Before removing any parts from the hydraulic system, park the machine on a level surface, lower attachment, and stop the engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.



WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

2. Jack up rear wheel and use wood blocks to keep the rear tire off the floor.
3. Remove lug nuts from drive studs. Pull wheel from drive studs and wheel hub.
4. Apply parking brake. Remove lock nut from wheel motor shaft. Release parking brake.
5. Use a puller to remove brake drum and wheel hub. Remove woodruff key from the wheel motor shaft.
6. Remove retaining clip securing the cam shaft to the brake lever. Separate lever from cam.

NOTE: The brake assembly consists of return spring, brake cam, brake shoes, backing plate, and anchor pin.

7. Remove brake assembly from the brake bracket by removing four lock nuts and cap screws from the backing plate and brake bracket. Do not disassemble.
8. Clean wheel motor and hydraulic connections. Label all connections for reassembly.

NOTE: The right wheel motor has an extra hydraulic tube and fitting attached to it.

NOTE: On the **SP 2020/3020**, the hydraulic connections between the tubes and motor fittings are JIC connections and use no O-rings.

9. Disconnect hydraulic tubes from the hydraulic fittings. Allow tubes to drain into a suitable container.

10. Remove hydraulic fittings and O-rings from the wheel motor. Put caps or plugs on disconnected tubes and motor ports to prevent contamination from entering.

NOTE: On the **SP 2020/3020**, two hex nuts are used with the top two cap screws when securing the wheel motor to the frame.

11. Remove hex nuts, cap screws, spacers, and lock washers securing the brake bracket and wheel motor to the frame. Remove motor from the frame.

Installation (Fig. 57 or 56)

NOTE: On the **SP 2020/3020**, two hex nuts are used with the top two cap screws when securing the wheel motor to the frame.

1. Position wheel motor to the frame. Secure motor and brake bracket to the frame with four cap screws, spacers, lock washers, and hex nuts.
2. Remove caps or plugs from the wheel motor. Lubricate **new** O-rings with clean hydraulic fluid. Install O-rings and hydraulic fittings to the motor and tighten.

NOTE: The right wheel motor has an extra hydraulic tube and fitting attached to it.

NOTE: On the **SP 2020/3020**, the hydraulic connections between the tubes and motor fittings are JIC connections and use no O-rings.

3. Install hydraulic tubes to the hydraulic fittings. Tighten tube connections.

NOTE: The brake assembly consists of return spring, brake cam, brake shoes, backing plate, and retaining clip.

4. Install brake assembly to the brake bracket by securing the backing plate to the brake bracket with four cap screws and lock nuts. Secure brake lever to the brake cam with the retaining clip.

IMPORTANT: DO NOT hit wheel hub with a hammer during installation. Hammering may cause damage to the motor.

5. Install woodruff key to the wheel motor shaft. Slide brake drum and hub onto the motor shaft.

6. Secure lock nut to the wheel motor shaft. Torque nut from 250 to 400 ft-lb (34.6 to 55.3 kg-m).

7. Install rim to the drive studs. Secure rim with lug nuts. Torque nuts from 40 to 50 ft-lb (5.5 to 6.9 kg-m).

8. Charge hydraulic system (see Charge Hydraulic System).

Rear Wheel Motors (SP 5020)

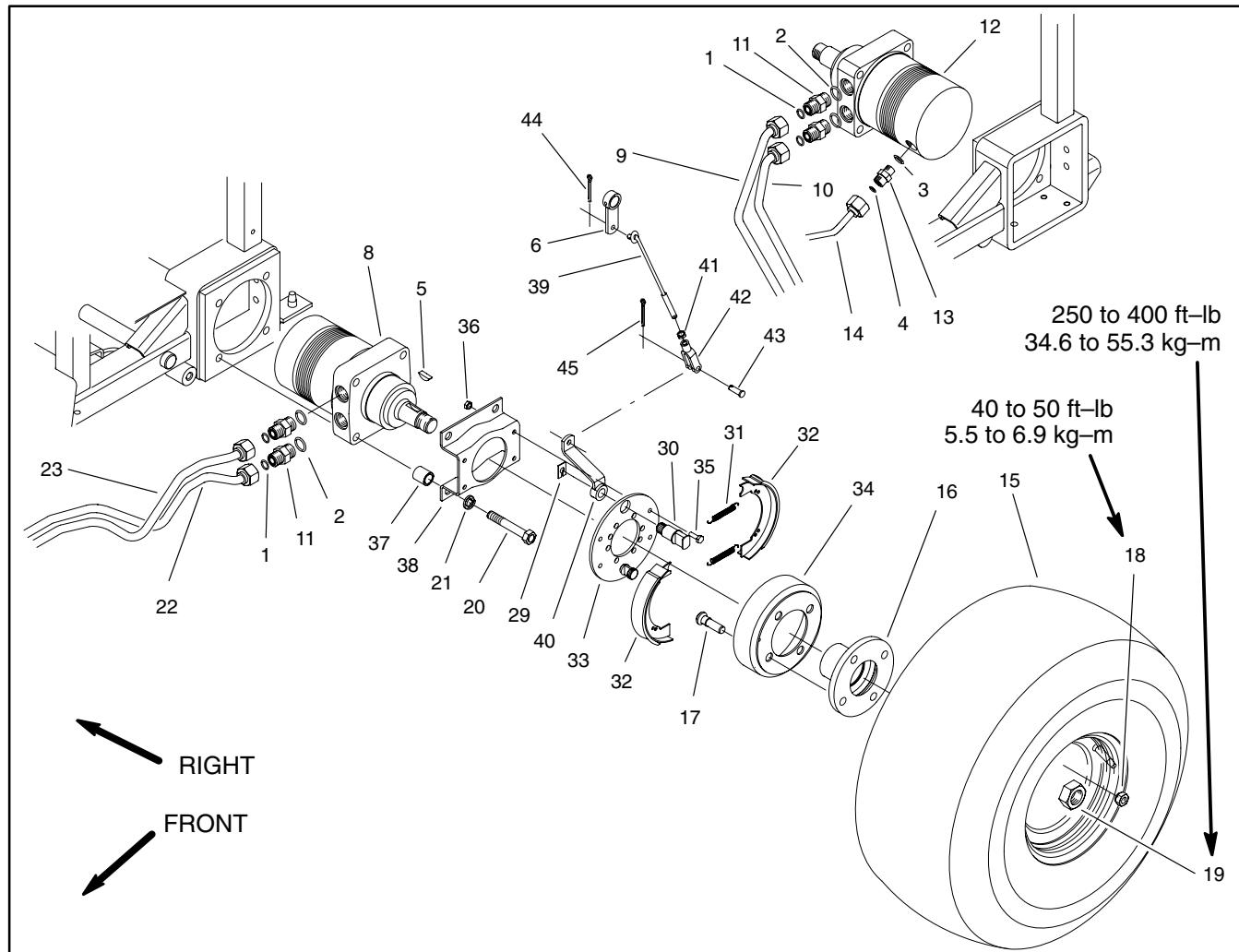


Figure 57

- | | | |
|--------------------------------|--------------------|-----------------------|
| 1. O-ring | 16. Wheel hub | 31. Extension spring |
| 2. O-ring | 17. Drive stud | 32. Brake shoe |
| 3. O-ring | 18. Lug nut | 33. Backing plate |
| 4. O-ring | 19. Lock nut | 34. Brake drum |
| 5. Woodruff key | 20. Cap screw | 35. Cap screw |
| 6. Brake lever | 21. Lock washer | 36. Lock nut |
| 7. Not used | 22. Hydraulic tube | 37. Spacer |
| 8. Left wheel motor | 23. Hydraulic tube | 38. Brake bracket |
| 9. Hydraulic tube | 24. Not used | 39. Rod adjustment |
| 10. Hydraulic tube | 25. Not used | 40. Brake lever |
| 11. Hydraulic straight fitting | 26. Not used | 41. Jam nut |
| 12. Right wheel motor | 27. Not used | 42. Adjustment clevis |
| 13. Hydraulic straight fitting | 28. Not used | 43. Clevis pin |
| 14. Hydraulic tube | 29. Retainer | 44. Cotter pin |
| 15. Tire | 30. Cam shaft | 45. Cotter pin |

Removal (Fig. 57 or 58)

1. Before removing any parts from the hydraulic system, park the machine on a level surface, lower attachment, and stop the engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.



WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

2. Jack up rear wheel and use wood blocks to keep the rear tire off the floor.
3. Remove lug nuts from drive studs. Pull wheel from drive studs and wheel hub.

IMPORTANT: DO NOT hit wheel hub with a hammer during removal. Hammering may cause damage to the motor.

4. Apply parking brake. Remove lock nut from wheel motor shaft. Release parking brake.
5. Use a puller to remove brake drum and wheel hub. Remove woodruff key from the wheel motor shaft.
6. Remove retaining clip securing the cam shaft to the brake lever. Separate lever from cam.

NOTE: The brake assembly consists of return spring, brake cam, brake shoes, backing plate, and anchor pin.

7. Remove brake assembly from the brake bracket by removing four lock nuts and cap screws from the backing plate and brake bracket. Do not disassemble.
8. Clean wheel motor and hydraulic connections. Label all connections for reassembly.

NOTE: The right wheel motor has an extra hydraulic tube and fitting attached to it.

9. Disconnect hydraulic tubes and O-rings from the hydraulic fittings. Allow tubes to drain into a suitable container.

10. Remove hydraulic fittings and O-rings from the wheel motor. Put caps or plugs on disconnected tubes and motor ports to prevent contamination from entering.

11. Remove hex cap screws, spacers, and lock washers securing the brake bracket and wheel motor to the frame. Remove motor from the frame.

Installation (Fig. 57 or 59)

1. Position wheel motor to the frame. Secure motor and brake bracket to the frame with four cap screws, spacers, and lock washers.

2. Remove caps or plugs from the wheel motor. Lubricate **new** O-rings with clean hydraulic fluid. Install O-rings and hydraulic fittings to the motor and tighten.

NOTE: The right wheel motor has an extra hydraulic tube and fitting attached to it.

3. Lubricate **new** O-rings with clean hydraulic fluid. Install O-rings and hydraulic tubes to the hydraulic fittings. Tighten tube connections.

NOTE: The brake assembly consists of return spring, brake cam, brake shoes, backing plate, and retaining clip.

4. Install brake assembly to the brake bracket by securing the backing plate to the brake bracket with four cap screws and lock nuts. Secure brake lever to the brake cam with the retaining clip.

IMPORTANT: DO NOT hit wheel hub with a hammer during installation. Hammering may cause damage to the motor.

5. Install woodruff key to the wheel motor shaft. Slide brake drum and hub onto the motor shaft.
6. Secure lock nut to the wheel motor shaft. Torque nut from 250 to 400 ft-lb (34.6 to 55.3 kg-m).
7. Install rim to the drive studs. Secure rim with lug nuts. Torque nuts from 40 to 50 ft-lb (5.5 to 6.9 kg-m).
8. Charge hydraulic system (see Charge Hydraulic System).

Wheel Motor Service

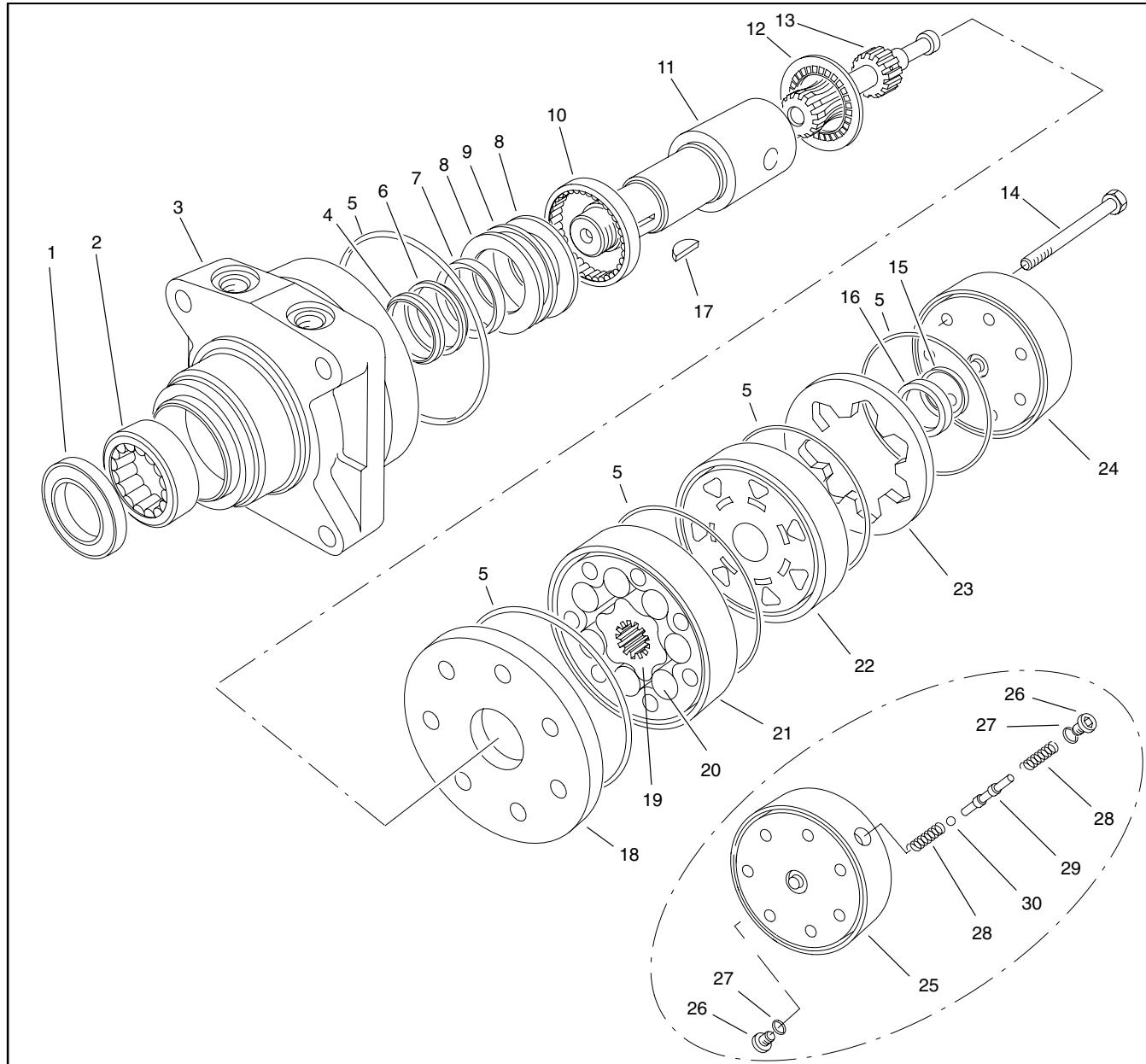


Figure 60

- | | | |
|----------------------|---------------------|-------------------------------------|
| 1. Dirt & water seal | 11. Coupling shaft | 21. Stator |
| 2. Bearing | 12. Thrust bearing | 22. Manifold |
| 3. Housing | 13. Drive link | 23. Commutator ring |
| 4. Back-up washer | 14. Cap screw | 24. End cover assembly (Front & LH) |
| 5. Seal ring | 15. Commutator seal | 25. End cover assembly (RH) |
| 6. Back-up washer | 16. Commutator | 26. Plug |
| 7. Inner seal | 17. Woodruff key | 27. O-ring (RH) |
| 8. Thrust washer | 18. Wear plate | 28. Spring (RH) |
| 9. Thrust bearing | 19. Rotor | 29. Shuttle valve (RH) |
| 10. Bearing | 20. Vane | 30. Ball (RH) |

Disassembly (Fig. 60)



WARNING

If the wheel motor is not held firmly in the vise, it could dislodge during service and cause injury.

1. Place wheel motor in a soft jawed vice with the coupling shaft (11) pointed down and the vise jaws clamping firmly on the sides of the housing (3).
2. Scribe an alignment mark down and across the wheel motor components from the end cover (24 or 25) to the housing (3) for facilitating reassembly (Fig. 61).
3. Loosen both plugs (26) on end cover (25). Remove seven cap screws (14). Remove end cover assembly (24 or 25) and seal ring (5).
4. Remove commutator ring (23).



CAUTION

Use eye protection such as goggles when using compressed air.

5. Remove commutator (16) and commutator seal (15). Remove commutator seal from the commutator using an air hose to blow air into the ring groove until the commutator seal is lifted out (Fig. 62).

NOTE: The manifold (22) is constructed of plates bonded together to form an integral component not subject to further disassembly for service. Compare configuration of both sides of the manifold to make sure that the same surface is reassembled against the rotor set.

6. Remove manifold (22). Remove seal rings (5) that are on both sides of the manifold.

NOTE: The rotor set consists of the rotor (19), vanes (20), and stator (21). Rotor set components may become disassembled during service procedures. Do not serviced separately.

NOTE: Marking all rotor set components and mating spline components for exact repositioning at assembly will maximize the wear life and performance of the rotor set and wheel motor.

7. Mark surface of rotor (19) and stator (21) that is facing up with etching ink or a grease pencil before removing from the wheel motor. This will make sure correct reassembly of the rotor into the stator and the rotor set into wheel motor.

8. Remove rotor set and wearplate (18) together, and retain the rotor set in its assembled form with the same vane (20) to stator (21) contact surfaces. The drive link (13) may come away from the coupling shaft (11) with the rotor set and wearplate. You may have to shift the rotor set on the wearplate to work the drive link out of the rotor (19) and wearplate (Fig. 63).

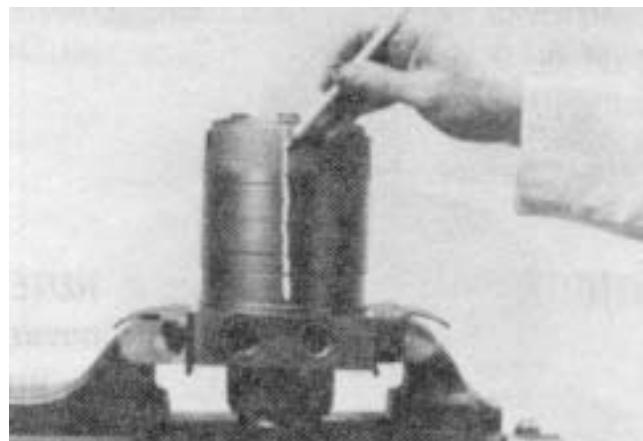


Figure 61



Figure 62



Figure 63

9. Remove seal ring (5) that is between the rotor set and wearplate (18).
 10. Remove drive link (13) from the coupling shaft (11) if it was not removed with rotor set and wear plate (18). Remove seal ring (5) from housing (3).
 11. Remove thrust bearing (12) from the top of the coupling shaft (11).
 12. Check exposed portion of coupling shaft (11). Removed all signs of rust and corrosion which might prevent its withdrawal of shaft through the dirt and water seal (1) and outer bearing (2). Crocus cloth or fine emery paper may be used.
 13. Remove coupling shaft (11) from the housing (3); push on the output end of the shaft.
 14. Remove inner seal (7) and back-up washers (4 and 6) from the housing by working them around the unseated thrust washers (8) and thrust bearing (9). **Do not remove the thrust washer** (Fig. 64).
 15. Remove housing (3) from the vise and invert it. Remove dirt and water seal (1). A blind hole bearing or seal puller is required.
- IMPORTANT: NOTE position of the springs (28), shuttle valve (29), and ball (30) as they are removed from end cover (24).**
16. Match mark **one** plug (26) and end cover (24). Remove that plug and O-ring (27). Remove springs (28), shuttle valve (29), and ball (30). Remove remaining plug and O-ring.

Inspection (Fig. 60)

1. Inspect bolts (14) for damaged threads and sealing rings under the bolt head. Replace if damaged (Fig. 65).

NOTE: A polished pattern (not scratches) on the end cover (24 or 25) from rotation of the commutator (16) is normal. Discoloration would indicate excess fluid temperature, thermal shock, or excess speed and require system investigation for cause and close inspection of end cover, commutator, manifold, and rotor set.



CAUTION

Use eye protection such as goggles when using compressed air.

2. Thoroughly wash end cover (24 or 25) in proper solvent and blow dry. Make sure end cover valve apertures are free of contamination. Inspect end cover for cracks and bolt head recesses for good bolt head sealing surfaces. Replace end cover as necessary (Fig. 66).



Figure 64



Figure 65

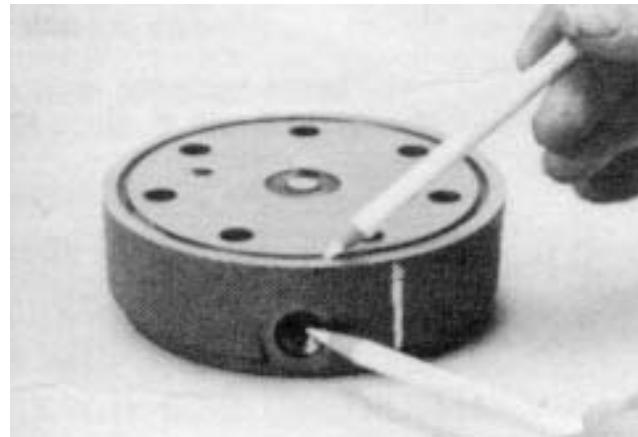


Figure 66

6. Inspect manifold (22) for cracks, surface scoring, peening, chipping. Replace manifold if any of these conditions exist. A polished pattern on the ground surface from commutator or rotor rotation is normal.

NOTE: The rotor set consists of the rotor (19), vanes (20), and stator (21). Rotor set components may become disassembled during service procedures.

7. Inspect rotor set in its assembled form for nicks, scoring, and chipping on any surface. Inspect for broken and worn splines. **If the rotor set component requires replacement, the complete rotor set must be replaced as it is a matched set.**

8. Place rotor set and wear plate (18) on a flat surface and center the rotor (19) in the stator (21) such that two rotor lobes (180 degrees apart) and a roller vane (20) center line are on the same stator center line. Check the rotor lobe to roller vane clearance with a feeler gage at this common center line. If there is more than 0.005 inch (0.13 mm) of clearance, replace the entire rotor set (Fig. 67).

9. Inspect the wearplate (18) for cracks, peening, and scoring. A polished pattern on the wear plate from rotor rotation is normal. Replace as necessary.

10. Inspect drive link (13) for cracks and worn or damaged splines. No perceptible backlash (play) should be noted between mating spline parts of the rotor (19) or coupling shaft (11). Replace as necessary (Fig. 68).

11. Inspect thrust bearing (12) for wear, peening, corrosion and a full complement of retained rollers. Replace as necessary.

12. Inspect coupling shaft (11) internal and external splines and keyway for damage and wear. Inspect bearing and sealing surfaces of the coupling shaft for chipping, nicks, grooves, severe wear, corrosion, and discoloration. Replace coupling shaft if any of these conditions exist. Minor shaft wear in seal area is permissible. If wear exceeds 0.020 inch (0.51 mm) diametrical, replace coupling shaft. A slight "polish" is permissible on the shaft bearing areas (Fig. 69).

NOTE: Do not remove inner bearing (10), thrust washers (8), thrust bearing (9), and outer bearing (2) from the housing (3). These parts should be inspected in place.

13. Inspect housing (3) for cracks. Inspect machined surfaces for nicks, burrs, peening, and corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. If the housing is defective in these areas, discard the housing assembly (Fig. 70).

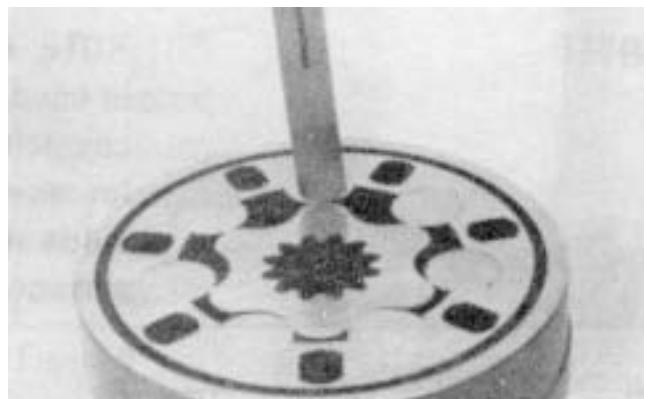


Figure 67



Figure 68

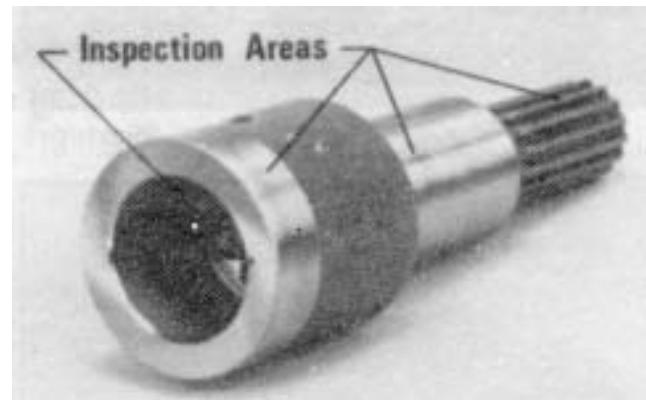


Figure 69

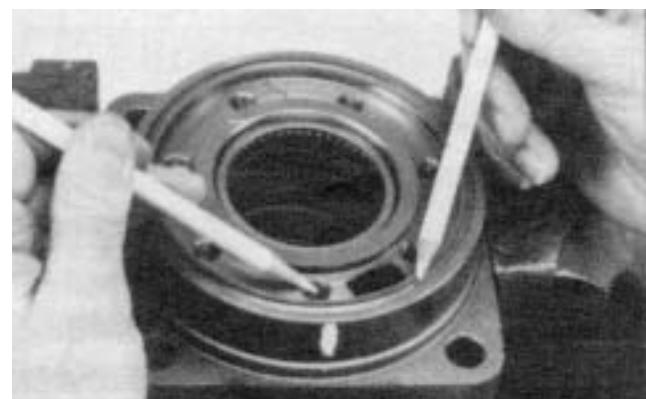


Figure 70

14. If the housing (3) has passed inspection to this point, inspect outer bearing (2), inner bearing (10), thrust washers (8), and thrust bearing (9). Bearing rollers must be firmly retained in the bearing cages but must rotate and orbit freely. All rollers and thrust washers must be free of peening and corrosion. **If any bearing or thrust washer does not pass inspection, replace the housing (3) as a complete assembly** (Fig. 71).

Assembly (Fig. 60)

1. Lubricate all seals and seal rings with clean hydraulic oil before assembly.



WARNING

Since they are flammable, be extremely careful when using any solvent. Even a small explosion or fire could cause injury or death.



CAUTION

Use eye protection such as goggles when using compressed air

2. Wash all parts in a clean petroleum-based solvent before assembly. Blow parts dry with compressed air.
3. Press a new dirt and water seal (1) into the housing (3) outer bearing counterbore. Press seal in with the lip facing out and until the seal is 0.020 inch (0.51 mm) below the end of housing.
4. Place housing (3) into a soft jawed vise with the coupling shaft bore down; clamp against the mounting flange.

IMPORTANT: Early model wheel motors that do not have back-up washer (6), assemble with a new back-up washer (4), new back-up washer (6), and new seal (7).

5. A housing (3) that does not require replacement will require that the two thrust washers (8) and thrust bearing (9) be unseated and vertical to the counterbore and the new back-up washer (4), new back-up washer (6), and new seal (7) be worked around the thrust bearing package and placed into their respective counterbores (Fig. 73 and 72). The seal lip must face out of the seal counterbore and toward the inside of wheel motor (Fig. 74). Be sure the thrust bearing package is reseated correctly after assembly of the new seal and back-up washers.

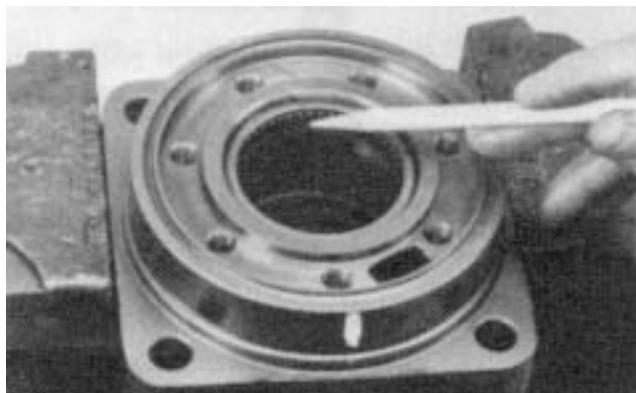


Figure 71



Figure 72



Figure 73

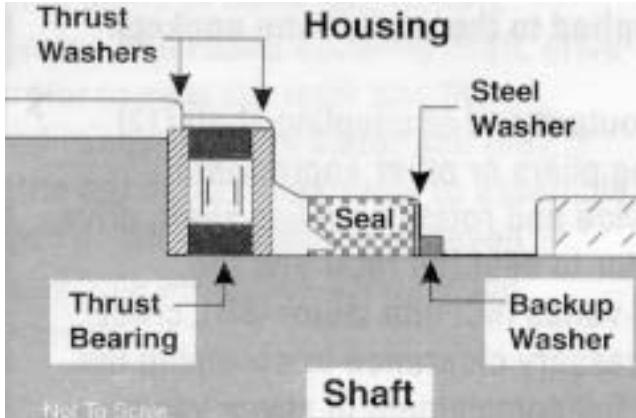


Figure 74

6. Apply masking tape around splines or keyway on coupling shaft (11) to prevent damage to seal.

IMPORTANT: The outer bearing (2) is not lubricated by the system's hydraulic fluid. Make sure it is thoroughly packed with Mobil Mobilith SHC ® 460 grease.

NOTE: Coupling shaft (11) should be approximately 0.10 inch (2.54 mm) below the housing wear plate surface to allow the assembly of the thrust bearing (12). The coupling shaft must rotate smoothly on the thrust bearing (9) and thrust washer (8) (Fig. 76).

7. Make sure that a generous amount of clean corrosion resistant grease has been applied to the outer bearing (2). Install the coupling shaft (11) into housing (3), and seat shaft against the second thrust washer (8).

8. Install thrust bearing (12) onto the end of coupling shaft (11).

9. Apply a small amount of clean petroleum jelly to a new seal ring (5) and insert it into the housing (3) seal ring groove.

NOTE: One or two alignment studs screwed finger tight into housing (3) bolt holes, approximately 180 degrees apart, will facilitate the assembly and alignment of components as required in the following procedures. The studs can be made by cutting off the heads of 3/8–24 UNF 2A bolts so they are 0.5 inch (12.7 mm) or longer than cap screw (14).

NOTE: Use any alignment marks put on the coupling shaft (11) and drive link (13) before disassembly to assemble the drive link splines in their original position in the mating coupling shaft splines.

10. Install drive link (13) with the long splined end down into the coupling shaft (11). Engage the drive link splines so they mesh with the coupling shaft splines (Fig. 77).

11. Assemble wear plate (18) over the drive link (13) and alignment studs onto the housing (3) (Fig. 78).

12. Apply a small amount of clean petroleum jelly to a new seal ring (5) and assemble it into the seal ring groove on the wear plate side of the stator (21).



Figure 75

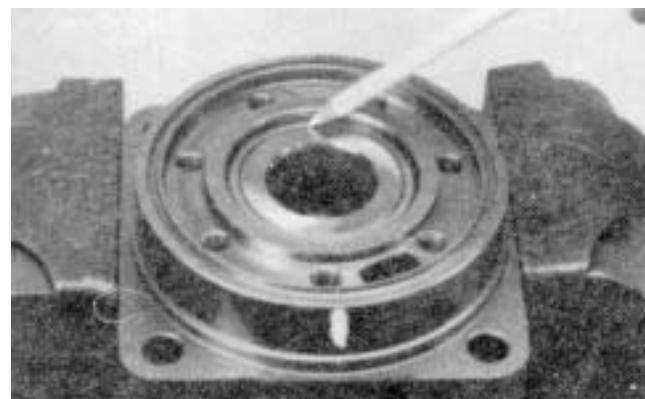


Figure 76



Figure 77



Figure 78

NOTE: The rotor set consists of the rotor (19), vanes (20), and stator (21). Rotor set components may become disassembled during service procedures. Do not service separately.

NOTE: It may be necessary to turn one alignment stud out of the housing (3) temporarily to assemble rotor set over the drive link (13).

NOTE: The rotor set rotor counterbore side must be down against wear plate for drive link clearance and to maintain the original rotor-drive link spline contact. A rotor set without a counterbore and that was not etched before disassembly can be reinstalled using the drive link spline pattern on the rotor splines if apparent, to determine which side was down. The rotor set seal ring groove faces toward the wear plate (18).

13. Install assembled rotor set onto wear plate (18) with rotor (19) counterbore and seal ring side down. Splines should mesh with the drive link (13) splines (Fig 79).

14. If disassembled rotor (19), stator (21), and vanes (20) cannot be readily assembled by hand, assemble with the following procedures:

A. Place stator (21) onto wear plate (18) with seal ring (5) side down. Be sure the seal ring is in place (Fig. 80).

B. If assembly alignment studs are not being utilized, align stator (21) bolt holes with wear plate (18) and housing (3) bolt holes. Screw two cap screws (14) finger tight into bolt holes approximately 180 degrees apart to retain stator and wear plate stationary.

NOTE: If the manifold (22) side of the rotor (19) was etched during wheel motor disassembly, this side should be up. If the rotor is not etched and does not have a counterbore, use the drive link spline contact pattern apparent on the rotor splines to determine the rotor side that must be against the wear plate.

C. Place rotor (19) with counterbore down, if applicable, into stator (21), and then onto wearplate (18) so rotor splines mesh with drive link (13) splines (Fig. 81).

IMPORTANT: Do not force rotor vanes into place, the coating applied to stator vane pockets could shear off.

D. Assemble six vanes (20), or as many vanes that will readily assemble into the stator vane pockets (Fig. 82).



Figure 79

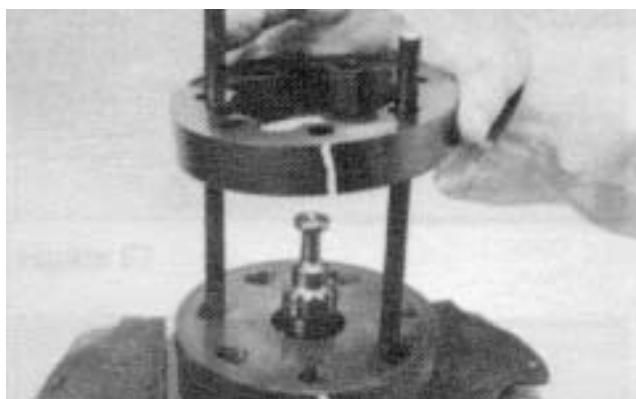


Figure 80

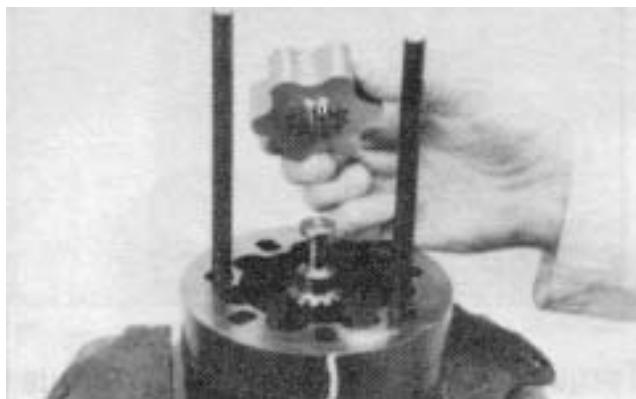


Figure 81



Figure 82

E. Grasp the output end of coupling shaft (11) with locking pliers or other appropriate turning device. Rotate coupling shaft, drive link (13), and rotor (19) to seat the rotor and the assembled vanes (20) into the stator (21). This rotation should create the necessary clearance to assemble the seventh or remaining vanes. Use minimum force when assembling the remaining vanes (Fig. 83).

F. Remove the two assembled bolts (14) if used to retain stator and wear plate.

NOTE: The manifold (22) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has it's series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression left on the manifold by the rotor set is another indication of which surface must contact the rotor set.

15. Apply clean petroleum jelly to a new seal ring (5) and assemble it in the seal ring groove in the rotor set contact side of manifold (22).

16. Assemble the manifold (22) over the alignment studs and drive link (13) and onto the rotor set. Be sure the correct manifold surface is against the rotor set.

17. Apply clean petroleum jelly to a new seal ring (5) and insert it in the seal ring groove exposed on the manifold (22).

18. Assemble the commutator ring (6) over alignment studs onto the manifold (22) (Fig. 84).

19. Assemble a new commutator seal (15) flat side up, into commutator (16) and assemble commutator over the end of drive link (13) onto manifold (22) with seal ring side up.

20. Assemble new seal ring (5) into end cover (24) and assemble end cover over the alignment studs and onto the commutator set.

21. Assemble seven cap screws (14) and screw them in finger tight. Remove and replace the two alignment studs with bolts after the other bolts are in place. Alternately and progressively tighten the bolts to pull the end cover and other components into place with a final torque of 45 to 55 ft-lb (6.2 to 7.6 kg-m) (Fig. 85).

IMPORTANT: Make sure springs (28), shuttle valve (29), and ball (30) are installed into the end cover (24) in the same position noted during disassembly.

22. Install plug (26) that is not matched marked and **new** O-ring (27) into shuttle port that is not matched marked. Install springs (28), shuttle valve (29), and ball (30) into open shuttle port. Install remaining plug and **new** O-ring.

23. Torque both plugs from 9 to 12 ft-lb (1.2 to 1.7 kg-m).

24. Check motor shaft for rotation. Torque require to rotate shaft should not exceed 50 ft-lb (6.9 kg-m).

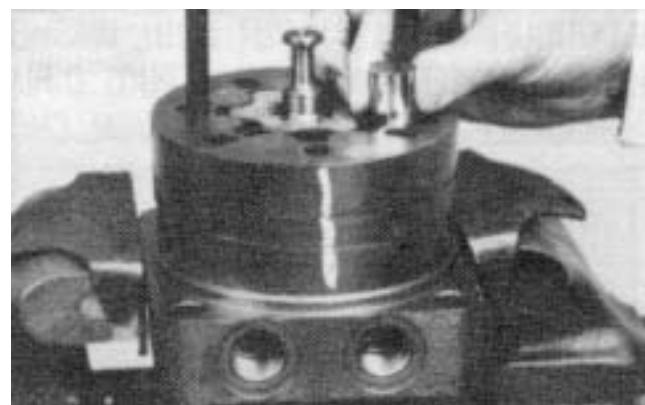


Figure 83



Figure 84

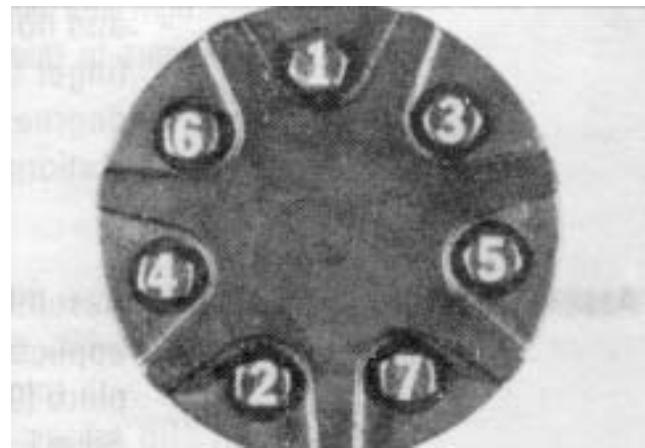


Figure 85

Hydraulic Tank (SP 2020/3020)

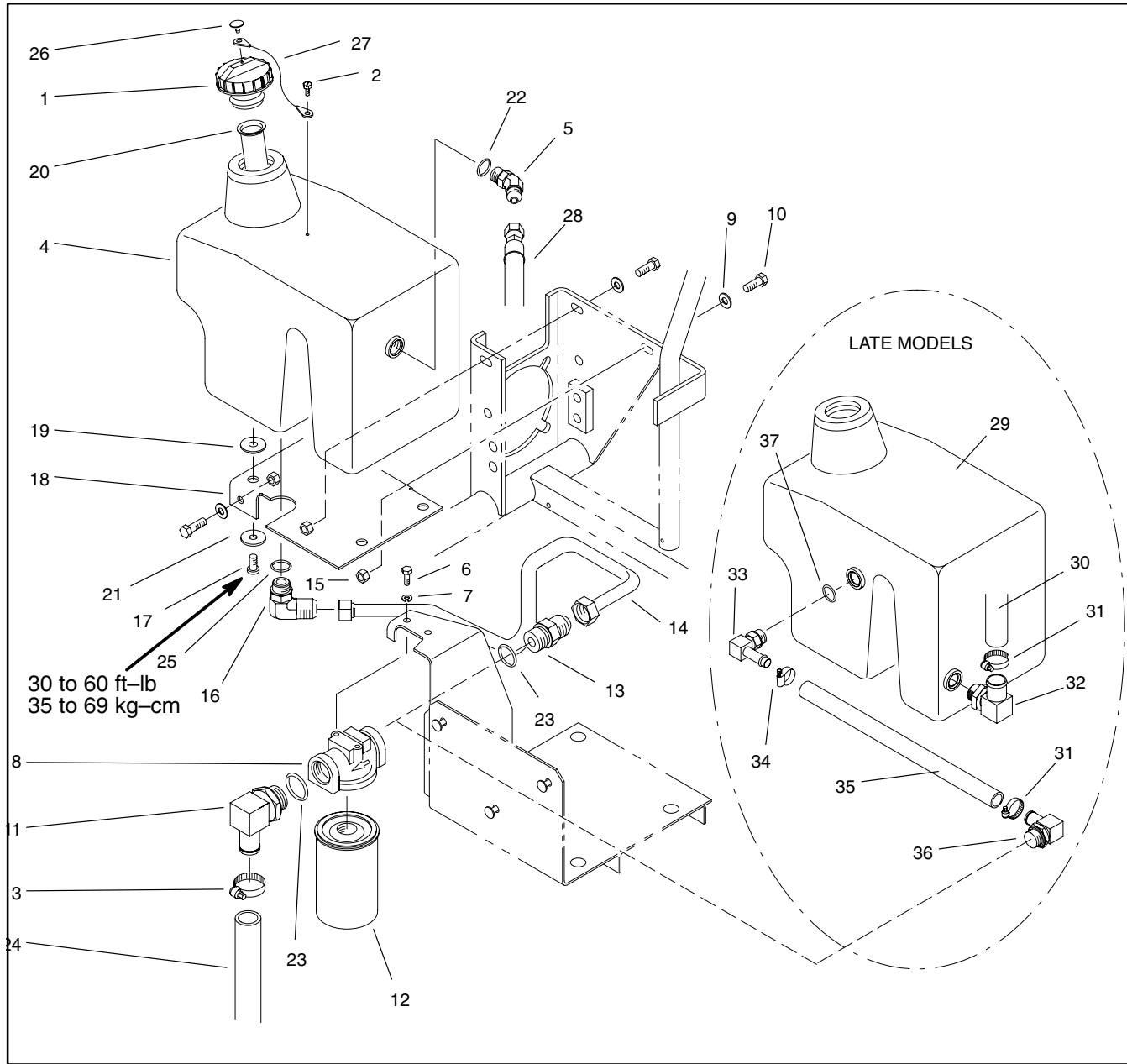


Figure 86

- | | | |
|---------------------------|---------------------------|----------------------------------|
| 1. Oil cap | 14. Hydraulic hose | 26. Tether retainer |
| 2. Shoulder screw | 15. Lock nut | 27. Oil cap tether |
| 3. Worm clamp | 16. 90° hydraulic fitting | 28. Hydraulic hose |
| 4. Hydraulic tank | 17. Cap screw | 29. Hydraulic tank |
| 5. 45° hydraulic fitting | 18. Tank base | 30. Return hose |
| 6. Cap screw | 19. Grommet | 31. Hose clamp |
| 7. Lock washer | 20. Filter screen | 32. Push on hose fitting |
| 8. Filter head | 21. Flat washer | 33. Barb fitting |
| 9. Flat washer | 22. O-ring | 34. Hose clamp |
| 10. Cap screw | 23. O-ring | 35. Suction hose |
| 11. 90° hydraulic fitting | 24. Hydraulic hose | 36. 90° degree hydraulic fitting |
| 12. Oil fitting | 25. O-ring | 37. O-ring |
| 13. Hydraulic fitting | | |

NOTE: Tank (29), hoses (30 and 35), hose clamps (31 and 34), fittings (32, 33, and 36), and O-ring (37) replace tank (4), hoses (28 and 14), fittings (5, 13, and 16), and O-rings (22, 23, and 25).

Removal (Fig. 86)

1. Before removing any parts from the hydraulic system, park machine on a level surface, set brake, lower attachment, and stop engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

2. Pivot seat up. Remove cover from the midsection of the machine.
3. Unscrew knob from lift lever. Remove lift valve shroud as explained in Lift Valve Removal and Installation (SP 2020/3020).
4. Clean hydraulic fittings and hydraulic hoses attached to the hydraulic tank. Clean tank in the area of these hoses.
5. Label all hydraulic connections for reassembly.
6. Place a suitable container under hydraulic fitting (16 or 33) to collect hydraulic oil.
7. Disconnect hose (14 or 35) from hydraulic fitting (16 or 33). Allow fluid to drain completely from the tank into the container.
8. Disconnect hose (28 or 30) from hydraulic fitting (5 or 32). Allow fluid to drain into a suitable container.
9. Put caps or plugs on disconnected hoses and fittings to prevent contamination.
10. Remove three lock nuts (15), cap screws (10), and flat washers (9), securing the tank base (18) to the frame. Pull tank and base from the frame.

Inspection (Fig. 86)

1. Clean tank (4 or 29) and filler screen (20) with solvent.
2. Inspect tank for leaks, cracks, or other damage.
3. Replace hydraulic hoses if worn or leaking.
4. Make sure cap screws (17) fit tightly into the tank. If loose, remove and reinstall cap screws with antiseize lubricant on the threads. Torque cap screws from 30 to 60 in-lb (35 to 69 kg-cm).
5. Make sure hydraulic fittings are tight and do not leak.

Installation (Fig. 86)

NOTE: Apply antiseize lubricant or to the threads of cap screws prior to installation.

1. If the hydraulic tank (4 or 29) was separated from the tank base (18), secure the base to the tank with three cap screws (17), flat washers (21), and grommets (19). Torque cap screws from 30 to 60 in-lb (35 to 69 kg-cm).
2. If removed from the hydraulic tank (4 or 29), install the following:
 - A. O-ring (22) and 45° hydraulic fitting (5).
 - B. O-ring (25) and hydraulic fitting (16).
 - C. O-ring (37) and barb fitting (33).
 - D. Push on hose fitting (32).
3. Position tank (4 or 29) and tank base (18) to the frame. Secure base to the frame with three cap screws (10), flat washers (9), and lock nuts.
4. Remove caps or plugs from disconnected hoses and fittings.
5. Reconnect hose (28 or 30) to hydraulic fitting (5 or 32).
6. Reconnect hose (14 or 35) to hydraulic fitting (16 or 33).
7. Reinstall lift valve shroud as explained in Lift Valve Removal and Installation (SP 2020/3020).
8. Screw knob onto lift lever.
9. Reinstall cover to the midsection of the machine. Pivot seat down.
10. Fill hydraulic tank with hydraulic fluid (see Check Hydraulic System Fluid and Change Hydraulic System Oil and Filter).
11. Start machine. Run engine at lowest idle speed for 3 to 5 minutes to circulate hydraulic fluid and remove any air trapped in the system. Stop machine and recheck hydraulic tank level.

Hydraulic Oil Cooler (SP 2020/3020)

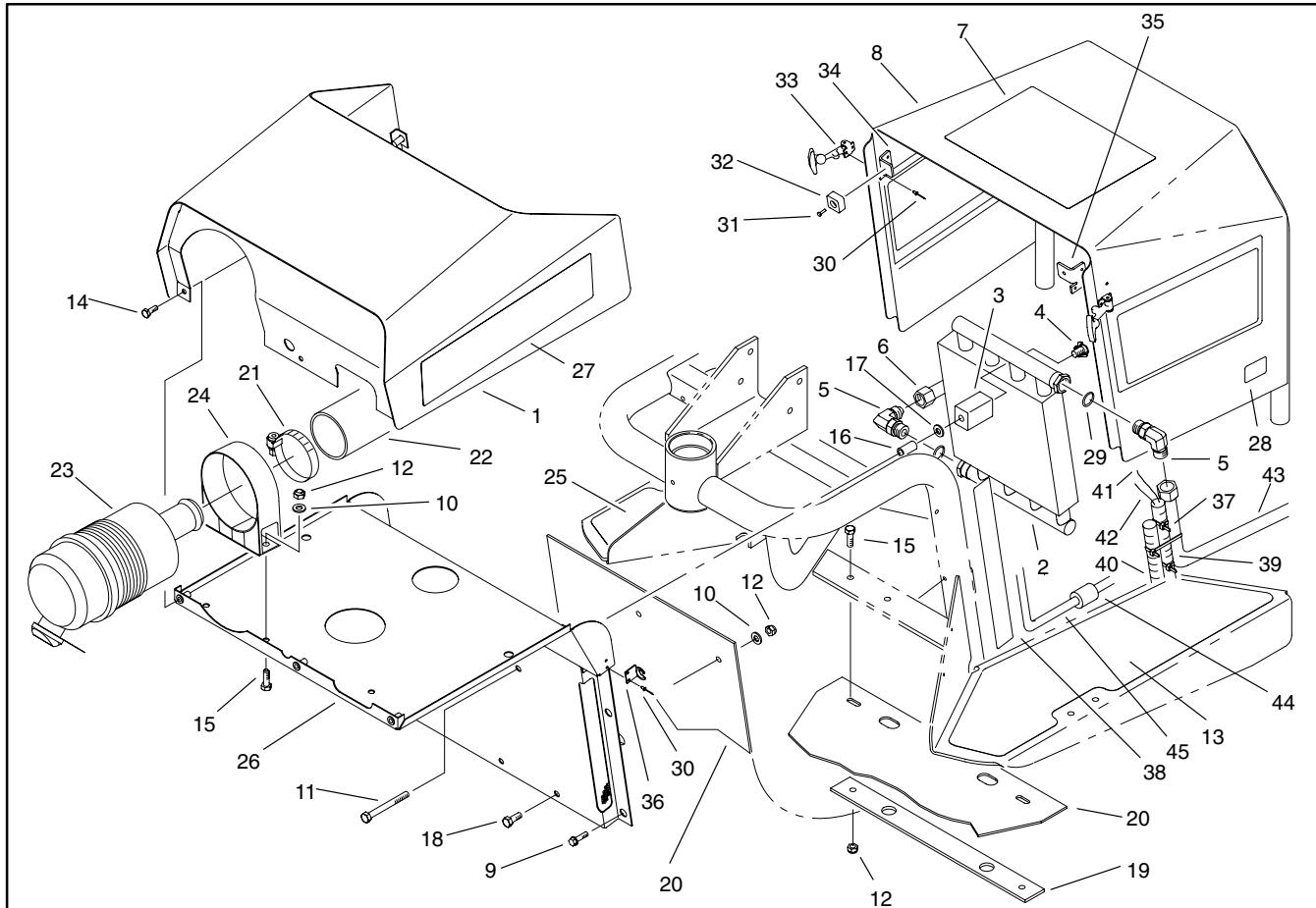


Figure 87

- | | | |
|--------------------------|--------------------|-------------------------------------|
| 1. Hood | 16. Spacer | 31. Semitubular rivet |
| 2. Oil cooler | 17. Flat washer | 32. Rubber pad |
| 3. Rubber clamp | 18. Cap screw | 33. Latch handle |
| 4. T-nut | 19. Retainer strip | 34. Bracket (RH) |
| 5. 90° hydraulic fitting | 20. Rubber shield | 35. Bracket (LH) |
| 6. Valve to cooler tube | 21. Hose clamp | 36. Keeper |
| 7. Operating decal | 22. Air hose | 37. Wire tie |
| 8. Cover | 23. Air cleaner | 38. Wear strip |
| 9. Flat head screw | 24. Mounting band | 39. Convoluted tube |
| 10. Flat washer | 25. Floor tread | 40. Wire harness |
| 11. Cap screw | 26. Front shield | 41. Wire assembly |
| 12. Lock nut | 27. Sand Pro decal | 42. Wire assembly |
| 13. Floor tread | 28. CE mark decal | 43. Hydraulic hose |
| 14. Flat head screw | 29. O-ring | 44. Rubber snubber |
| 15. Cap screw | 30. Pop rivet | 45. Front motor tube (SP 3020 only) |

Removal (Fig. 87)

1. Before removing any parts from the hydraulic system, park machine on a level surface, set brake, lower attachment, and stop engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

2. Pivot seat up. Remove cover (8) from the midsection of the machine.
3. Disconnect air hose attached to the air cleaner on the engine.
4. Remove both lock nuts (12), cap screws (15), and strip retainer (19) securing the lower part of the rubber shield (20) to the frame. Position shield away from the bottom of the oil cooler (2).
5. Clean both 90° hydraulic fittings (5), hydraulic hose (43), and valve to cooler tube (6). Clean oil cooler (2) in the area of these fittings.
6. Label all hydraulic connections for reassembly.
7. Place a suitable container under 90° hydraulic fitting (5) at the bottom of the oil cooler (2) to collect hydraulic oil.
8. Disconnect valve to cooler tube (6) from 90° hydraulic fitting (5). Allow fluid to drain from into the container.
9. Disconnect hydraulic hose (43) from 90° hydraulic fitting (5). Allow fluid to drain completely from the cooler into a suitable container.
10. Put caps or plugs on disconnected hoses and fittings to prevent contamination.
11. Remove both cap screws (11), spacers (16), and flat washers (17) from rubber clamps (3) and T-nuts (4).
12. Pull the oil cooler (2) from the machine.
13. Remove 90° hydraulic fittings (5) and O-rings (29) from the oil cooler (2).

Cleaning and Inspection (Fig. 87)

1. Back flush oil cooler with cleaning solvent (bottom opening to top opening). After cooler is clean, make sure all solvent is drained from the cooler.



CAUTION

Use eye protection such as goggles when using compressed air.

2. Dry inside of oil cooler using compressed air in the opposite direction of the oil flow (bottom opening to top opening).
3. Plug both ends of the oil cooler. Clean exterior of the cooler. Make sure fins are clear of dirt and debris.
4. The oil cooler should be free of corrosion, cracked tubes, and excessive pitting of tubes.

Installation (Fig. 87)

1. Make sure hydraulic both openings to the oil cooler are clean. Remove plugs from the cooler openings.
2. Reinstall O-rings (29) and 90° hydraulic fittings (5) to the oil cooler (2).
3. Position the oil cooler (2) to the front shield (26).
4. Secure oil cooler to the front shield (26) with both rubber clamps (3), flat washers (17), spacers (16), cap screws (11), and T-nuts (4).
5. Remove caps or plugs on disconnected hoses and fittings.
6. Reconnect valve to cooler tube (6) to 90° hydraulic fitting (5).
7. Reconnect hydraulic hose (43) to 90° hydraulic fitting (5).
8. Reinstall cover (8) to the midsection of the machine. Pivot seat down.
9. Fill tank with hydraulic fluid (see Check Hydraulic System Fluid and Change Hydraulic System Oil and Filter).
10. Charge hydraulic system (see Charge Hydraulic System).

Hydraulic Tank and Oil Cooler (SP 5020)

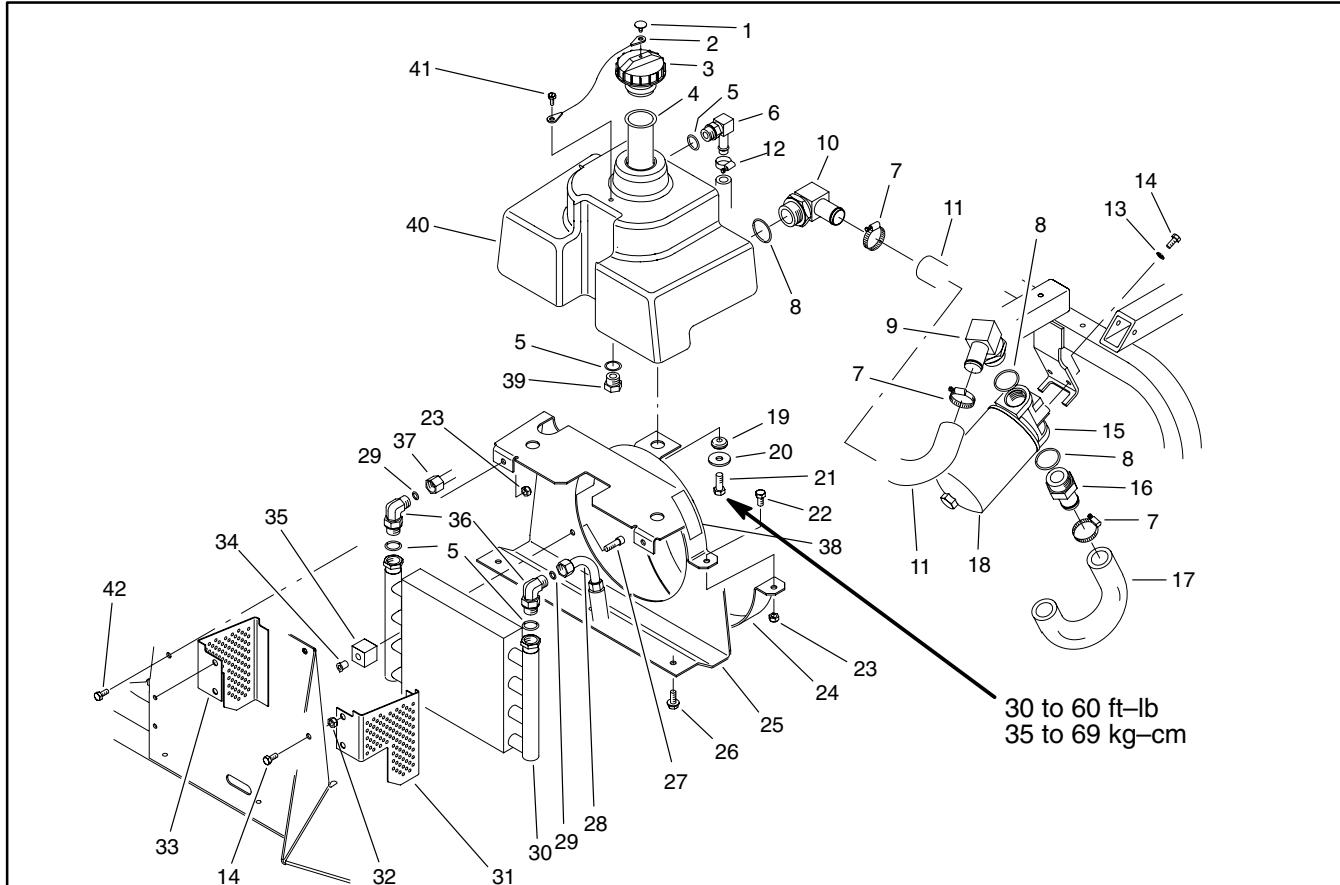


Figure 88

- | | | |
|---------------------------|--------------------------------|---------------------------|
| 1. Tether retainer | 15. Hydraulic filter head | 29. O-ring |
| 2. Tether | 16. Straight hydraulic fitting | 30. Oil cooler |
| 3. Tank cap | 17. Hydraulic hose | 31. Left hand screen |
| 4. Filler screen | 18. Hydraulic filter element | 32. Clinch nut |
| 5. O-ring | 19. Grommet | 33. Right hand screen |
| 6. 90° Hydraulic fitting | 20. Flat washer | 34. T-nut |
| 7. Hose clamp | 21. Cap screw | 35. Rubber clamp |
| 8. O-ring | 22. Cap screw | 36. 90° hydraulic fitting |
| 9. 90° hydraulic fitting | 23. Lock nut | 37. Hydraulic tube |
| 10. 90° hydraulic fitting | 24. Lower shroud | 38. Caution decal |
| 11. Hydraulic hose | 25. Cooler mount | 39. Drain plug |
| 12. Hose clamp | 26. Self tapping screw | 40. Hydraulic tank |
| 13. Lock washer | 27. Socket head screw | 41. Shoulder screw |
| 14. Cap screw | 28. Hydraulic hose | 42. Cap screw |

Oil Cooler Removal (Fig. 88)

- Before removing any parts from the hydraulic system, park machine on a level surface, set brake, lower attachment, and stop engine.



CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

- Pivot seat up. Remove left and right side panels from the machine. Remove left fender and seat (see Left Fender (Seat Base) Removal in Chapter 6 – Wheels, Brakes, and Miscellaneous).

- Disconnect air hose from the air cleaner. Remove lower shroud from the cooler mount. Disconnect control rod from the pump lever (Fig. 89).

- Clean around hydraulic fittings (36) on the oil cooler (30). Disconnect hydraulic tube (37) and hose (28) from the cooler. Allow fluid to drain into a suitable container.

- Put caps or plugs on disconnected hydraulic hose and tube to prevent contamination.



CAUTION

One person should operate the chain fall or jack while the other person guides the engine and hydrostat from the frame.

IMPORTANT: When moving the engine and hydrostat from the frame, make sure not to damage the cooling fan, wires, hoses, and cables.

6. Reposition hydrostat and engine as follows:
 - A. Position a jack or chain fall to the engine base.
 - B. Remove lock nuts, flat washers, and cap screws securing front engine mounts to the frame (Fig. 90).
 - C. Remove cap screws and flat washers securing the engine support to the frame (Fig. 48).
 - D. Lower and pull back hydrostat and engine from the cooler mount. Cooling fan must clear the mount.
7. Use flexible wire to secure the hydraulic tank (40) to the frame.
8. Remove cap screws (21) and flat washers (20) securing the hydraulic tank (40) to the cooler mount (25).
9. Remove three self tapping screws (26) securing the lower portion of the cooler mount (25) to the frame.
10. Remove both lock nuts (23) and cap screws (42) securing the upper front portion of the cooler mount (25) to the frame. Lower mount and cooler from the machine.
11. Separate oil cooler (40) from the cooler mount (25) by removing socket head screws (27) from the T-nuts (34) and rubber clamps (35).
12. Remove 90° hydraulic fittings (36) and O-rings (5) from the oil cooler (40). Put caps or plugs in cooler openings to prevent contamination.

Oil Cooler Inspection (Fig. 88)



CAUTION

Use eye protection such as goggles when using compressed air.

1. Back flush oil cooler with cleaning solvent (bottom opening to top opening). After cooler is clean, make sure all solvent is drained from the cooler.
2. Dry inside of oil cooler using compressed air in the opposite direction of the oil flow.

3. Plug both ends of oil cooler. Clean exterior of cooler. Make sure fins are clear of dirt and debris.

4. The oil cooler should be free of corrosion, cracked tubes, and excessive pitting of tubes.

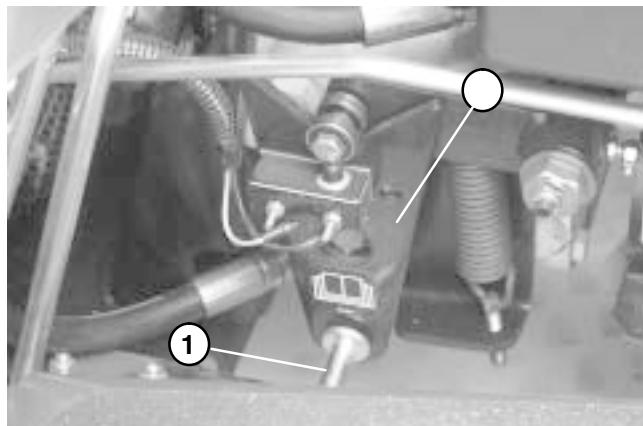


Figure 89

1. Control rod 2. Pump lever

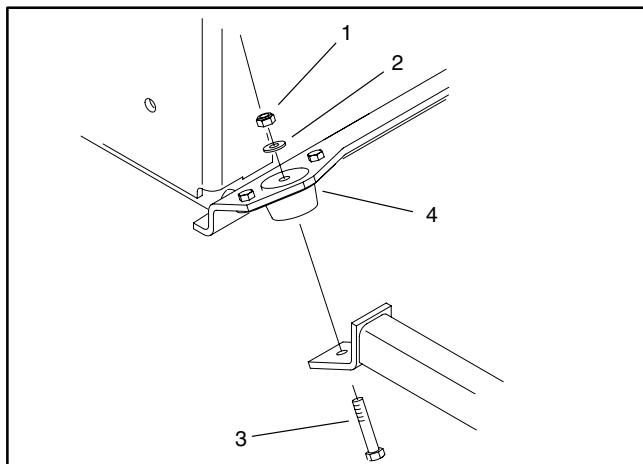


Figure 90

1. Lock nut 3. Cap screw
2. Flat washer 4. Front engine mount

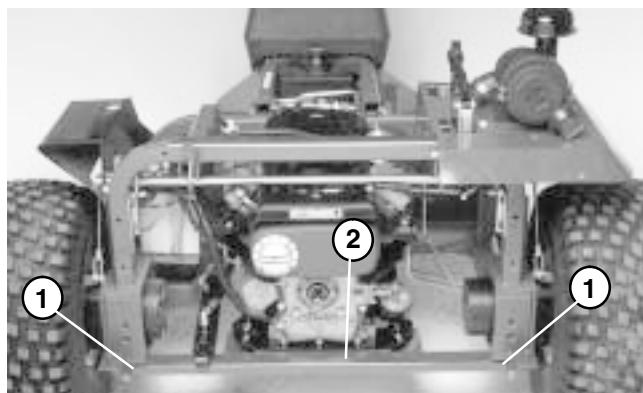


Figure 91

1. Cap screw & flat washer 2. Engine support

Oil Cooler Installation (Fig. 88)

1. Make sure both hydraulic openings to the oil cooler are clean. Remove plugs from the cooler openings.
2. Reinstall O-rings and 90° hydraulic fittings to the oil cooler. Torque fittings from 36 to 40 ft-lb (5.0 to 5.5 kg-m).
3. Secure oil cooler to cooler mount (25) with rubber clamps (35), socket head screws (27), and T-nuts (34).
4. Position cooler mount (25) and oil cooler (30) to the frame. Secure upper front portion of the mount to the frame with both cap screws (42) and lock nuts (23).
5. Secure lower portion of the cooler mount (25) to the frame with three self tapping screws (26).

NOTE: Apply antiseize lubricant or to the threads of cap screws prior to installation.

6. Make sure grommets (19) are installed into cooler mount (25). Secure hydraulic tank (40) to the mount with three cap screws (21) and flat washers (20). Torque cap screws from 30 to 60 in-lb (35 to 69 kg-cm).
7. Remove wire securing hydraulic tank (40) to the frame.



CAUTION

One person should operate the chain fall or hoist while the other person guides the engine into the frame.

8. Reinstall engine and hydrostat as follows:

IMPORTANT: When repositioning the engine and hydrostat to the frame, make sure not to damage the cooling fan, wires, hoses, and cables.

- A. Use jack or chain fall to position the front engine mounts and engine support to the frame.
- B. Secure engine mount to the frame with four cap screws and flat washers (Fig. 48).
- C. Secure front engine mounts to the frame with cap screws, flat washers, and lock nuts (Fig. 90).
- D. Remove jack or chain fall from the engine base.
9. Remove caps or plugs on disconnected hydraulic hose (28) and tube (37).
10. Make sure hydraulic fittings (36) on the oil cooler (30) are clean. Connect hydraulic tube (37) and hose (28) to the cooler.

11. Connect air hose to the air cleaner. Remove lower shroud to the cooler mount. Connect control rod to the pump lever (Fig. 89).

12. Install left fender and seat (see Left Fender (Seat Base) Installation in Chapter 6 – Wheels, Brakes, and Miscellaneous). Install left and right side panels to the machine.
13. Fill hydraulic tank (40) with hydraulic fluid (see Check Hydraulic System Fluid).
14. Charge hydraulic system (see Charge Hydraulic System).

Hydraulic Tank Removal (Fig. 88)

1. Disconnect oil cooler (40) and cooler mount (25) from the frame (see Oil Cooler Removal). **Do not** remove 90° hydraulic fittings (36) from the cooler.
2. Drain hydraulic tank (40) by removing drain plug (39). Allow hydraulic fluid to drain into a suitable container. Install plug back to tank.
3. Remove both hydraulic hose (28) and tube (37) from both 90° hydraulic fittings (36) on the tank.
4. Remove wire securing hydraulic tank to the frame. Remove tank from the frame.

Hydraulic Tank Inspection (Fig. 88)

1. Clean hydraulic tank (40) and filler screen (4) with solvent.
2. Inspect hydraulic tank (40) for leaks, cracks, or other damage.
3. Replace hydraulic hose (37) or tube (37) if worn or leaking.

Hydraulic Tank Installation (Fig. 88)

1. Position hydraulic tank (40) to the frame. Secure tank to the frame with a flexible wire.
2. Secure hydraulic hose (28) and tube (37) to both 90° hydraulic fittings (36) on the tank.
3. Connect oil cooler (40) and cooler mount (25) to the frame and hydraulic tank (40) (see Oil Cooler Installation).
4. Start machine. Run engine at lowest idle speed for 3 to 5 minutes to circulate hydraulic fluid and remove any air trapped in the system. Stop machine and recheck hydraulic tank level.



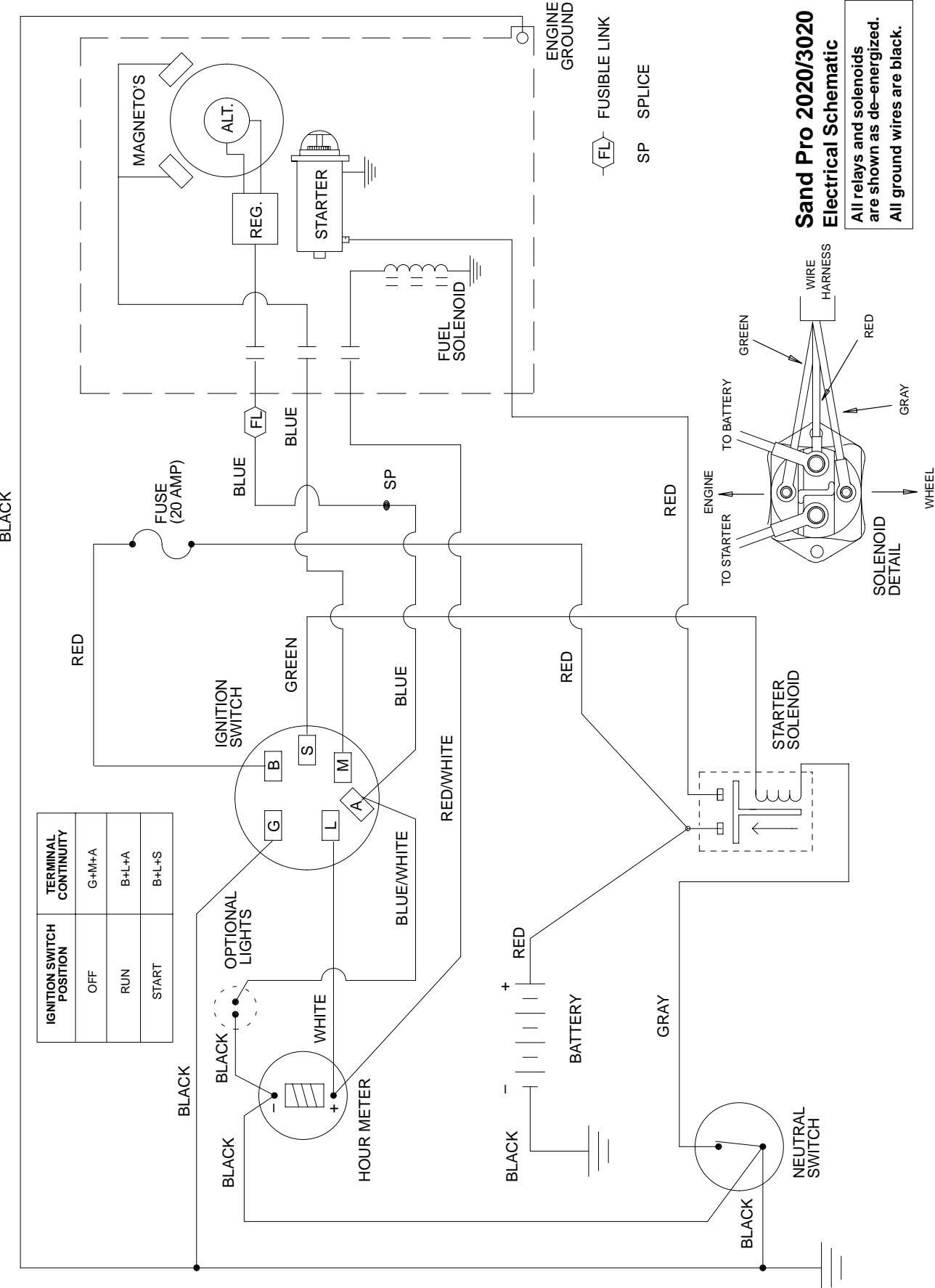
Chapter 5

Electrical Systems

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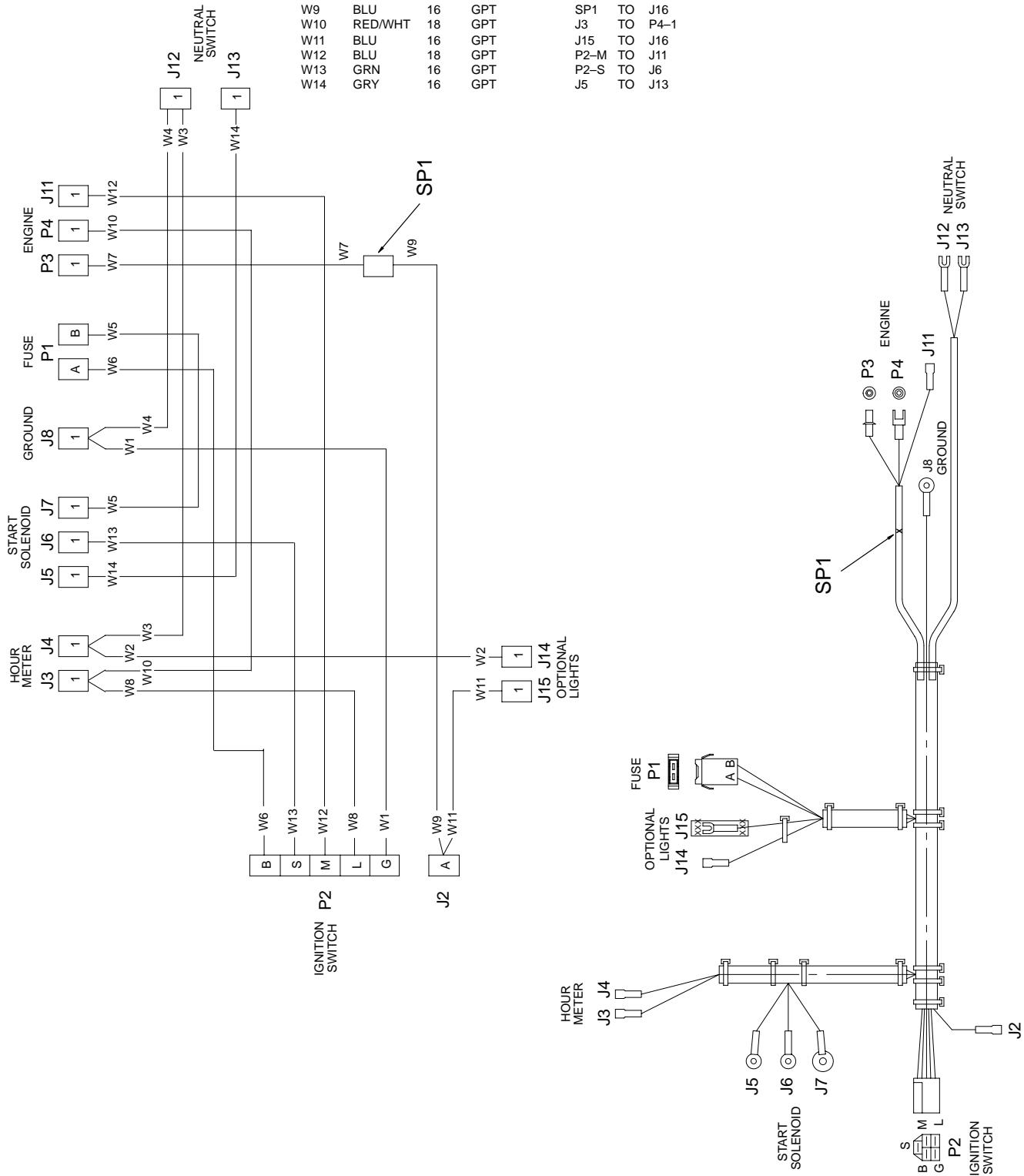
Electrical Schematics and Diagrams

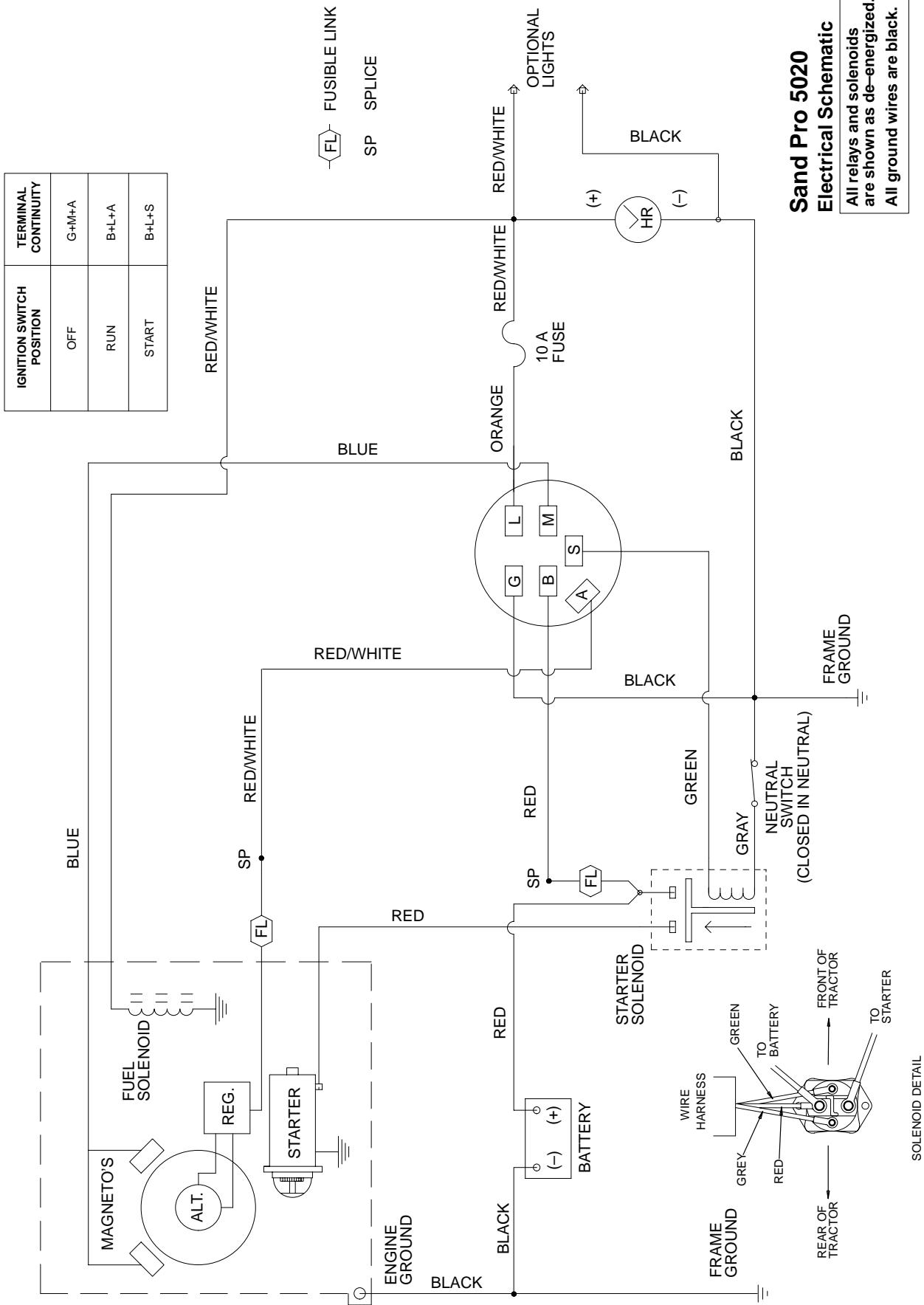


Sand Pro 2020/3020 Harness and Wiring Diagram

WIRE IDENTIFICATION			
LABEL	COLOR	AWG	TYPE
W1	BLK	16	GPT
W2	BLK	16	GPT
W3	BLK	16	GPT
W4	BLK	16	GPT
W5	RED	14	GPT
W6	RED	14	GPT
W7	BLU	18	FUSIBLE LINK
W8	WHT	18	GPT
W9	BLU	16	GPT
W10	RED/WHT	18	GPT
W11	BLU	16	GPT
W12	BLU	18	GPT
W13	GRN	16	GPT
W14	GRY	16	GPT

ROUTE	TO	J8
P2-G	TO	J8
J4	TO	J14
J4	TO	J12
J8	TO	J12
P1-B	TO	J7
P2-B	TO	P1-A
P3-1	TO	SP1
P2-L	TO	J3
SP1	TO	J16
J3	TO	P4-1
J15	TO	J16
P2-M	TO	J11
P2-S	TO	J6
J5	TO	J13





Sand Pro 5020
Electrical Schematic

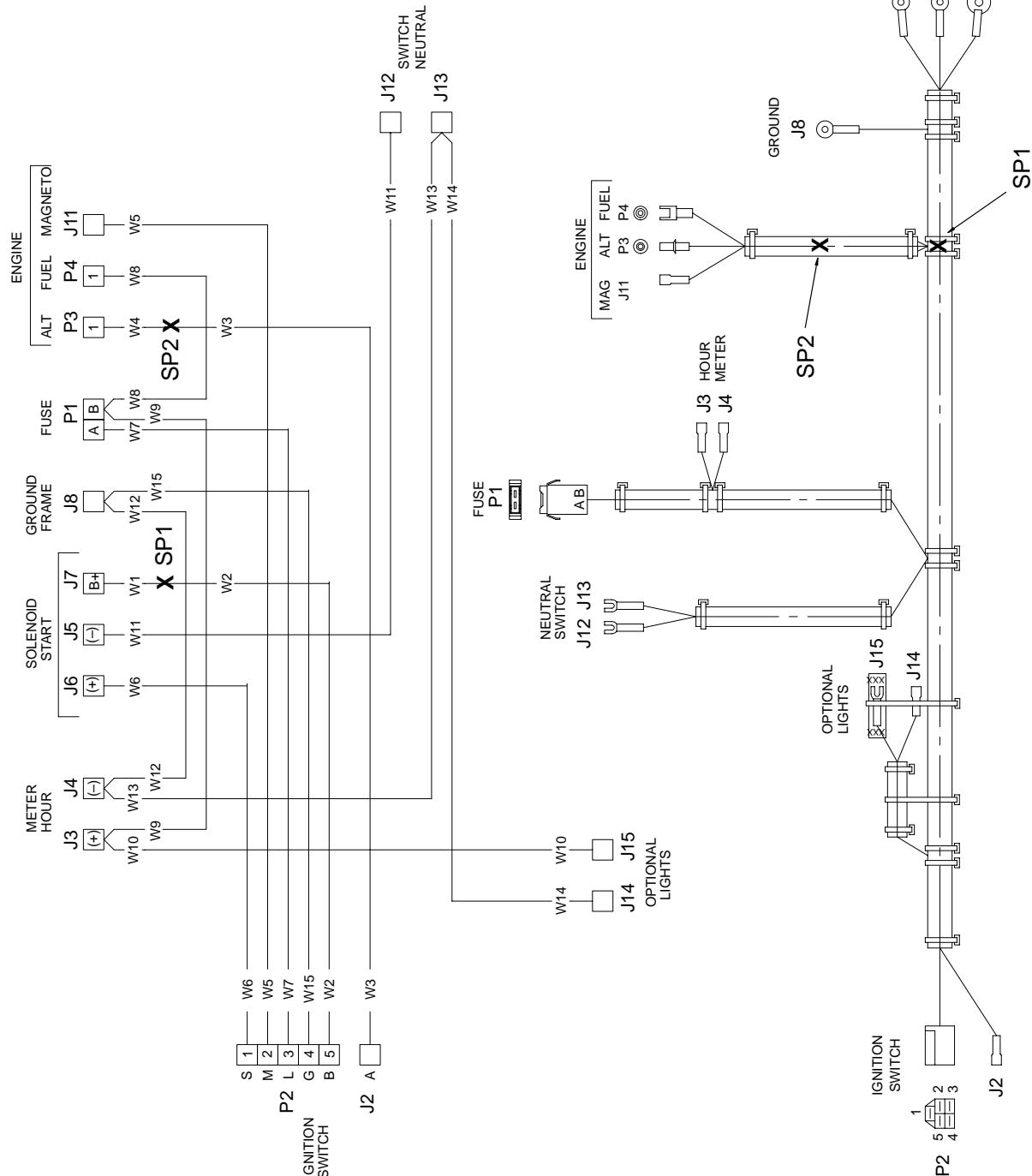
All relays and solenoids
are shown as de-energized.
All ground wires are blue.

- All relays and solenoids are shown as de-energized.
- All ground wires are black.

Sand Pro 5020 Harness and Wiring Diagram

WIRE IDENTIFICATION

LABEL	COLOR	AWG	TYPE	ROUTE
W1	N/A	18	FUSABLE LINK	J7 TO SP1
W2	RED	14	GPT	SP1 TO P2-5
W3	RED/WHT	14	GPT	J2 TO SP2
W4	N/A	18	FUSABLE LINK	SP2 TO P3-1
W5	BLU	18	GPT	P2-2 TO J11
W6	GRN	14	GPT	P2-1 TO J6
W7	ORG	14	GPT	P2-3 TO P1-A
W8	WHT/RED	18	GPT	P1-B TO P4-1
W9	WHT/RED	18	GPT	P1-B TO J3
W10	WHT/RED	18	GPT	J3 TO J15
W11	GRY	18	GPT	J5 TO J12
W12	BLK	18	GPT	J8 TO J4
W13	BLK	18	GPT	J4 TO J13
W14	BLK	18	GPT	J13 TO J14
W15	BLK	18	GPT	J8 TO P2-4



Special Tools

Order special tools from the *TORO SPECIAL TOOLS AND APPLICATIONS GUIDE (COMMERCIAL PRODUCTS)*.

Some tools may also be available from a local supplier.

Multimeter

The meter can test electrical components and circuits for current, resistance, or voltage.

NOTE: Toro recommends the use of a DIGITAL Volt-Ohm-Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

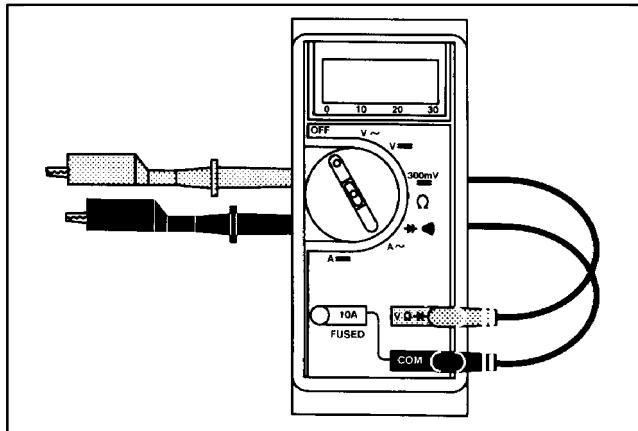


Figure 1

Skin-Over Grease

Special non-conductive grease (Toro Part No. 505-47) which forms a light protective skin which helps waterproof electrical switches and contacts.

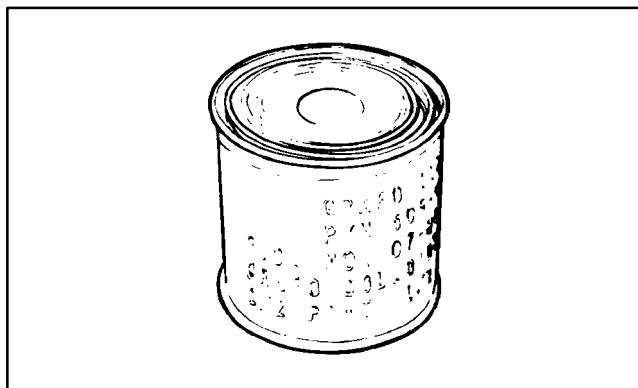


Figure 2

Troubleshooting



CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage.

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Wiring Schematics section of this chapter).

If the machine has any interlock switches bypassed, they must be reconnected for proper troubleshooting and safety.

Starting Problems

Problem	Possible Causes
Starter solenoid clicks, but starter will not crank (if solenoid clicks, problem is not in safety interlock system).	Battery charge is low. Battery cables are loose or corroded. Battery ground to frame is loose or corroded. Wiring at starter is faulty. Starter solenoid is faulty. Starter mounting bolts are loose or not supplying a sufficient ground for solenoid. Starter is faulty and causing an incomplete circuit for the solenoid.
Nothing happens when start attempt is made.	Battery is dead. Wiring to the starting circuitry (see Wiring Schematics) components is loose, corroded, or damaged. Battery cables are loose or corroded. Battery ground to frame is loose or corroded. 20 ampere fuse is open, loose, or missing. Fusible link to starter solenoid is open (SP 5020 only). Fuse block is faulty. Ignition switch is faulty. Starter solenoid is faulty. Neutral switch is out of adjustment or faulty.

Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	<p>Wiring to start circuitry (see Wiring Schematics) is loose, corroded, or damaged.</p> <p>10 ampere fuse is missing or open (SP 5020).</p> <p>Ignition switch is faulty.</p> <p>Fuel solenoid is faulty.</p> <p>Spark plugs are faulty.</p> <p>Engine or fuel system is malfunctioning (see Chapter 4 – Briggs & Stratton Vanguard Engine).</p> <p>Engine is out of fuel or may be to cold.</p>

General Run and Transport Problems

Problem	Possible Causes
Battery does not charge.	<p>Wiring to the charging circuit (see Wiring Schematics) components is loose, corroded, or damaged.</p> <p>Voltage regulator/alternator is faulty.</p> <p>20 ampere fuse is missing or open (SP 2020/3020).</p> <p>Fusible link is open.</p> <p>Ignition switch is faulty.</p> <p>Battery is dead.</p>

Electrical System Quick Checks

Battery Test (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals.

Set multimeter to the DC volts setting. The battery should be at a temperature of 60 to 100°F (16 to 38°C). The ignition key should be off and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (−) meter lead to the negative battery post.

NOTE: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information.

Voltage Measured	Battery Charge Level
12.68 V (or higher)	Fully charged (100%)
12.45 V	75% charged
12.24 V	50% charged
12.06 V	25% charged
11.89 V	0% charged

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the ignition switch connector before doing a continuity check).

NOTE: For more component testing information, see the Briggs and Stratton Vanguard Service and Repair Manual for 4-Cycle, V-Twin Cylinder, OHV Engines.

Ignition Switch

The ignition (key) switch has three positions (OFF, RUN, and START). The terminals are marked as shown. The circuitry of the ignition switch is shown in the chart. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

POSITION	CIRCUIT
OFF	G + M + A
RUN	B + L + A
START	B + L + S



CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

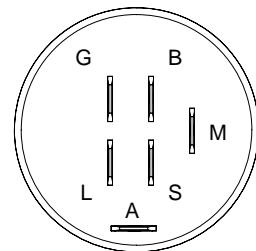


Figure 3

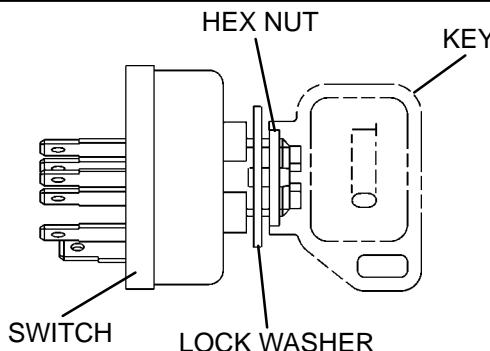


Figure 4

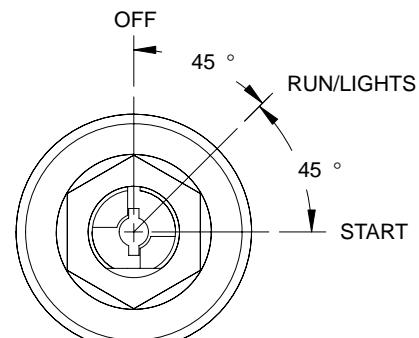


Figure 5

Hour Meter

IMPORTANT: Make sure to observe polarity on the meter label when testing. Damage to the meter may result from an improper connection.

1. Connect the positive (+) terminal of a 12 VDC source to the positive terminal of the hour meter.
2. Connect the negative (-) terminal of the voltage source to the other terminal of the hour meter.
3. The hour meter should move a 1/10 of an hour in six minutes.
4. Disconnect the voltage source from the hour meter.

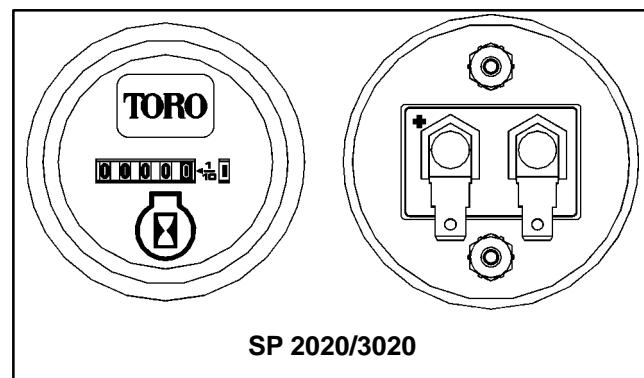


Figure 6

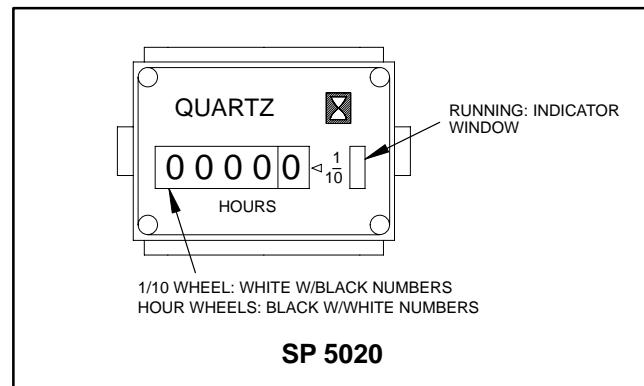


Figure 7

Starter Solenoid

NOTE: Prior to taking small resistance readings with a digital multimeter, short the test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Make sure engine is off. Disconnect solenoid electrical connections.
2. Apply 12 VDC directly across the solenoid coil posts. The solenoid should click. Make sure continuity across the main contact posts is **less than 1 ohm**.
3. Remove voltage from solenoid coil posts. The solenoid should click. Make sure reading across the main contact posts is **infinity ohms**.
4. Resistance across the solenoid coil posts should be **3.1 ohms**.
5. Replace starter solenoid if necessary. Reconnect electrical connections to solenoid.

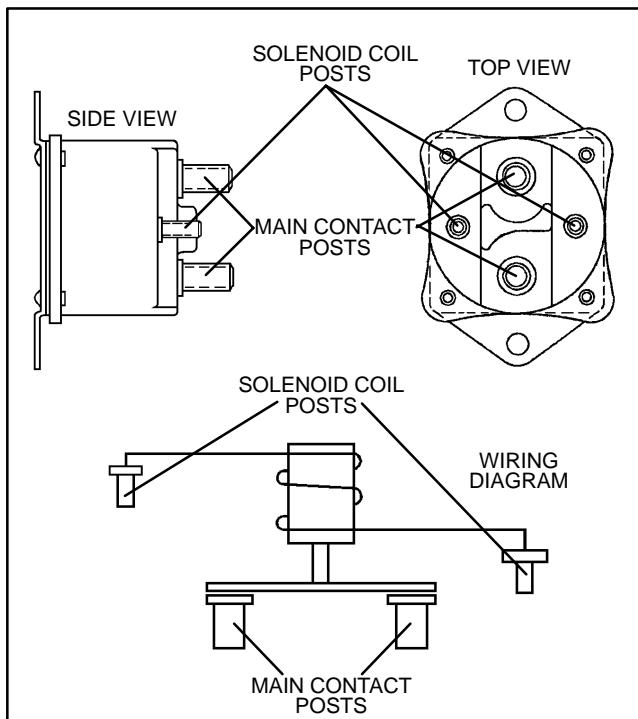


Figure 8

Neutral Switch

NOTE: Prior to taking small resistance readings with a digital multimeter, short the test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

This switch is closed when the traction pedal is in the neutral position. The switch is located on the pump lever, which is attached to the hydraulic pump assembly.

1. Make sure the engine is off.
2. Disconnect one of the electrical connections from the switch terminal posts.
3. Check continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.
4. With the traction pedal in the neutral position and the switch button depressed, resistance should be **less than 1 ohm** between the terminals.
5. With the traction pedal in the forward or backward position, there the meter should read **infinity ohms** across the terminals.
6. Replace switch if necessary. Connect electrical connections to the switch terminal posts.

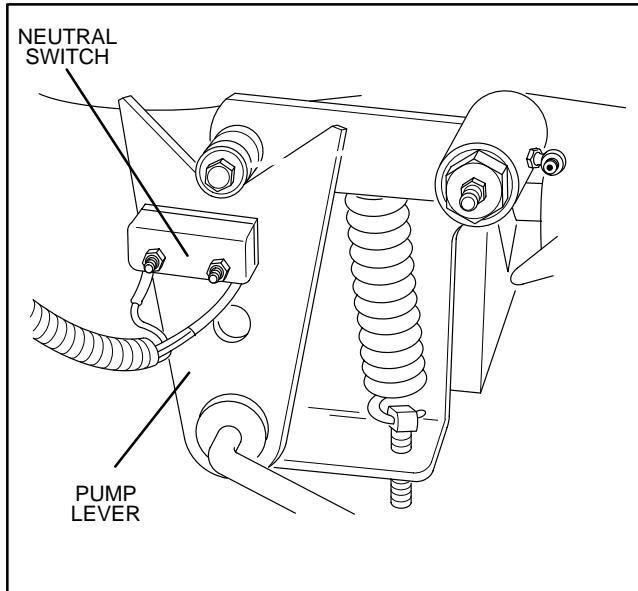


Figure 9

Service and Repairs

NOTE: For more component repair information, see the Briggs and Stratton Vanguard Service and Repair Manual for 4-Cycle, V-Twin Cylinder, OHV Engines.

Battery Storage

If the machine will be stored for more than 30 days

1. Remove the battery and charge it fully (see Battery Service).
2. Either store battery on a shelf or on the machine.

3. Leave cables disconnected if the battery is stored on the machine.
4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.
5. To help prevent the battery from freezing, make sure it is fully charged (see Battery Service).

Battery Care

1. Battery electrolyte level must be properly maintained. The top of the battery must be kept clean. If the machine is stored in a location where temperatures are extremely high, the battery will run down more rapidly than if the machine is stored in a location where temperatures are cool.

3. Battery cables must be tight on terminals to provide good electrical contact.



WARNING

Wear safety goggles and rubber gloves when working with electrolyte. Charge battery in a well ventilated place so gasses produced while charging can dissipate. Since the gases are explosive, keep open flames and electrical sparks away from the battery; do not smoke. Nausea may result if the gases are inhaled. Unplug charger from electrical outlet before connecting or disconnecting charger leads to or from battery posts.

2. Keep top of battery clean by washing periodically with a brush dipped in ammonia or bicarbonate of soda solution. Flush top surface with water after cleaning. Do not remove the fill cap while cleaning.



WARNING

Connecting cables to the wrong post could result in personal injury and/or damage to the electrical system.

4. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (-) cable first. Scrape clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat terminals with petroleum jelly.
5. Check electrolyte level every 25 operating hours, and every 30 days if machine is in storage.
6. Maintain cell level with distilled or demineralized water. Do not fill cells above the fill line.

Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.



CAUTION

When working with batteries, use extreme caution to avoid slashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Electrolyte Specific Gravity

Fully charged: 1.265 corrected to 80°F (26.7°C)

Discharged: less than 1.240

Battery Specifications

BCI Group Size UI:

280 CCA at 0° F (-17.8° C)

Reserve Capacity of 43 minutes at 25 amp and at 80°F (26.7°C)

Dimensions (not including terminal posts and caps)

Length 7.72 inches (19.60 cm)

Width 4.98 inches (12.65 cm)

Height 6.16 inches (15.65 cm)

Removal (Fig. 10 and 11)

IMPORTANT: Be careful not to damage terminal posts or cable connectors when removing the battery cables.

1. Remove wing nuts, washers, and battery clamp or hold down from battery hold down rod.
2. Remove lock nut and cap screw from ground cable (–) post first and remove cable from battery. This should prevent short circuiting the battery, other components, or the operators hands.
3. Remove lock nut and cap screw from positive (+) cable post and remove cable from battery.
4. Make sure manifold vent cap is on tightly.
5. Remove battery from the battery compartment to a service area. This will minimize possible battery damage and allow better access for inspection and service.

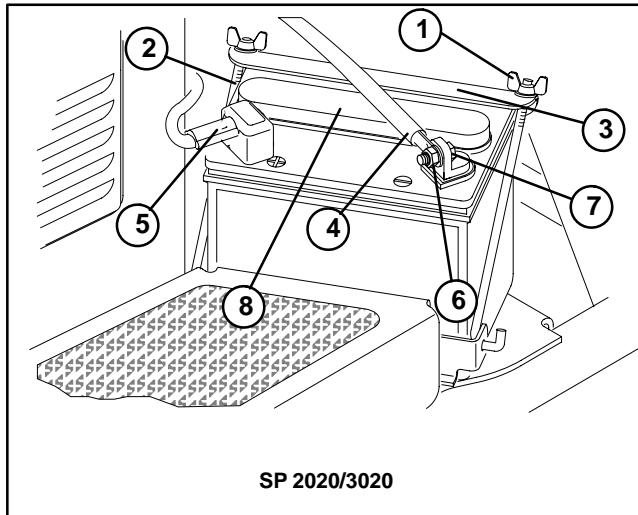


Figure 10

- | | |
|----------------------|------------------------|
| 1. Wing nut & washer | 5. Positive cable |
| 2. Hold down rod | 6. Lock nut |
| 3. Battery clamp | 7. Cap screw |
| 4. Negative cable | 8. Manifold vented cap |

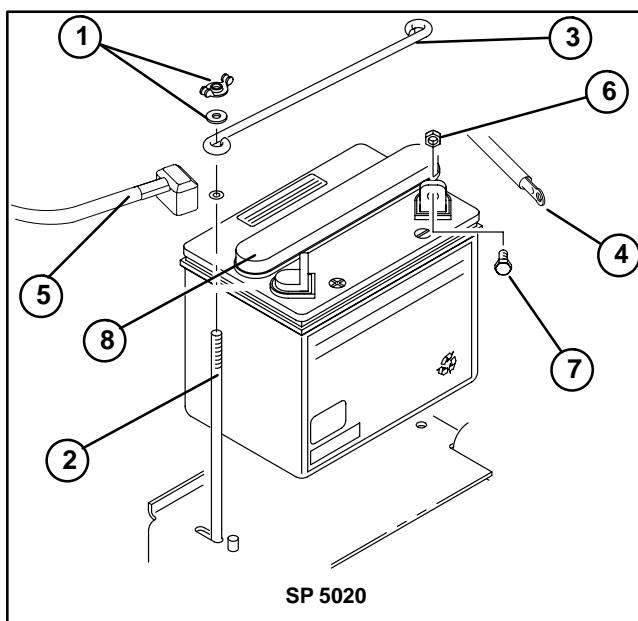


Figure 11

- | | |
|----------------------|------------------------|
| 1. Wing nut & washer | 5. Positive cable |
| 2. Hold down rod | 6. Lock nut |
| 3. Battery hold down | 7. Cap screw |
| 4. Negative cable | 8. Manifold vented cap |

Inspection, Maintenance, and Testing (Fig. 12)

1. Perform following inspections and maintenance:
 - A. Check for cracks caused by overly tight hold-down clamp. Replace battery if cracked and leaking.
 - B. Check battery terminal posts for corrosion. Use a terminal brush or steel wool to clean corrosion from the battery terminal posts.
 - C. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post, or overfilling. Also, check battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.
 - D. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.
 - E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled** water between the minimum and maximum fill lines. Charge at 15 to 25 amps for 15 minutes to allow sufficient mixing of the electrolyte.
2. Conduct a hydrometer test of the battery electrolyte.

IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

- A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to taking a reading to warm-up the hydrometer. At the same time take the temperature of the cell.
- B. Temperature correct each cell reading. For each 10°F (5.5°C) above 80°F (26.7°C) add 0.004 to the specific gravity reading. For each 10°F (5.5°C) below 80°F (26.7°C) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature	100°F
Cell Gravity	1.245
100°F minus 80°F equals 20°F (37.7°C minus 26.7°C equals 11.0°C)	
20°F multiply by $0.004/10^{\circ}\text{F}$ equals 0.008 (11°C multiply by $0.004/5.5^{\circ}\text{C}$ equals 0.008)	
ADD (conversion above)	<u>0.008</u>
Correction to 80°F (26.7°C)	1.253

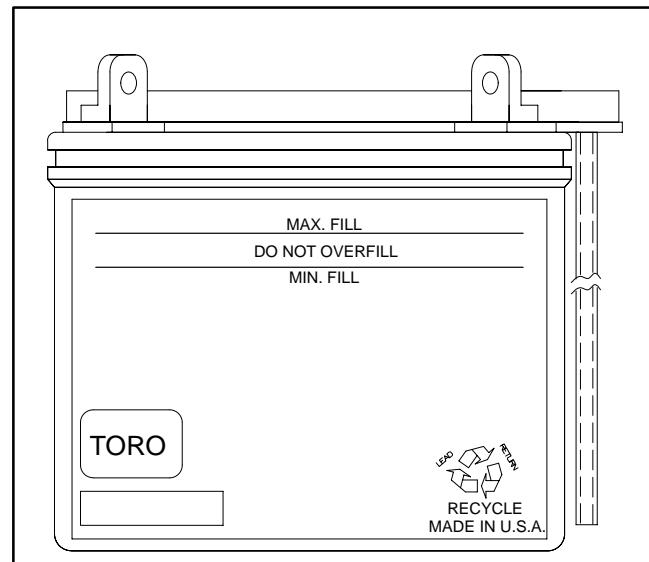


Figure 12

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

3. Perform a high-discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is **required** to perform this test.



- A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.4 VDC, recharge the battery.
- B. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.
- C. Make sure the battery terminals are free of corrosion.
- D. Measure the temperature of the center cell.

E. Connect a battery load tester to the battery terminals **following the manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of one half the Cranking Performance (see Battery Specifications) rating of the battery for 15 seconds.

G. Take a voltage reading at 15 seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the cell temperature reading.

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70°F (and up)	21.1°C (and up)
9.5	60°F	15.6°C
9.4	50°F	10.0°C
9.3	40°F	4.4°C
9.1	30°F	-1.1°C
8.9	20°F	-6.7°C
8.7	10°F	-12.2°C
8.5	0°F	-17.8°C

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Installation (Fig. 10 and 11)

IMPORTANT: To prevent possible electrical problems, install only a fully charged battery.

1. Make sure ignition switch and all accessories are off.
2. Make sure battery compartment is clean and repainted if necessary.
3. Make sure all battery cables and connections are in good condition and battery clamp or hold down has been repaired or replaced.
4. Place battery in its compartment. Make sure battery is level and flat. Connect positive cable connector onto positive battery post. Tighten cap screw and lock nut with two wrenches.
5. Secure battery clamp or hold down to the battery and hold down rod with the washer and wing nut. Do not overtighten to prevent cracking or distorting the battery case.

6. Apply a light coat of grease on all battery posts and cable connectors to reduce corrosion after connections are made.

7. Connect a digital multimeter (set to amps) between the negative battery post and the negative (ground) cable connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the unit's electrical system should be tested and repaired.

8. Connect negative (ground) cable connector to the negative battery post. Tighten cap screw and lock nut with two wrenches.

Charging

To minimize possible damage to the battery and allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is available in most shops.



CAUTION

Follow the manufacturer's instructions when using a battery charger.

NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its open specific gravity or circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the manufacturer's battery charger instructions** or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 amps	7.5 hrs @ 3 amps	11.3 hrs @ 3 amps	15 hrs @ 3 amps
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps



CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (15.5°C) before connecting to a charger.

Charge the battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

3. **Following the manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125°F (51.6°C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three consecutive readings.

Check Interlock System



WARNING

The interlock switch is for the operator's protection, so do not disconnect it. Check switch operation daily to assure proper interlock system operation. If the switch is defective, replace it before operating. Whether the switch is operating properly or not, replace it every two years to assure maximum safety. Do not rely entirely on safety switches – use good judgement!

The purpose of the interlock system is to prevent the engine from cranking or starting unless the traction pedal is in "NEUTRAL".

1. Check interlock operation in a wide open area free of debris and bystanders. Stop engine.

2. Sit on the seat. Depress traction pedal in forward and reverse directions, while trying to start the engine in each position. If the engine cranks with the pedal in either the forward or reverse position, there may be a malfunction in the interlock system. Repair problem immediately. If the engine does not crank, the system is operating correctly.

Optional Lights

After market lighting kits are available for the **SP 2020/3020** and **SP 5020**. These kits can be electrically connected to the machine's electrical system using the proper wiring diagram as a guide (see Sand Pro 2020/3020 or Sand Pro 5020 Harness and Wiring Diagrams).

IMPORTANT: Do not exceed a total lighting capacity of 150 watts on a machine. Exceeding this limit will damage the alternator.



Chapter 6

Wheels, Brakes, and Miscellaneous

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Wheels, Brakes,
and Miscellaneous

Specifications

Item	Description
Front tire pressure	4 to 6 PSI, (0.28 to 0.41 bar)
Rear tire pressure	4 to 6 PSI, (0.28 to 0.41 bar)
Wheel lug nut torque	45 to 55 ft-lb, (6.2 to 7.6 kg-m)

Adjustments

Adjust Steering Chain

NOTE: Since the chain and sprocket are subjected to sand thrown up by the front tire, inspect them frequently for wear. If either the chain or sprocket is worn beyond acceptable limits, replace both chain and sprocket.

NOTE: The steering chains on the **SP 2020/3020** (Fig. 1) and **SP 5020** (Fig. 2) are adjusted in the same manner. Newer models of the **SP 3020** have a chain guide similar to the **SP 5020**.

1. Place front wheel in the straight ahead position.
2. Adjust locknuts until the chain is snug on both sides of the sprocket.
3. Turn the steering wheel full left and full right to be sure the chain does not bind or hang up in either direction. Readjust chain as required.

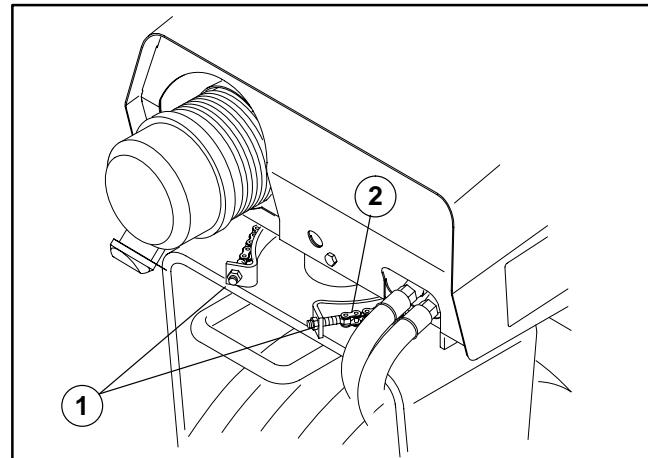


Figure 1

1. Lock nut 2. Chain

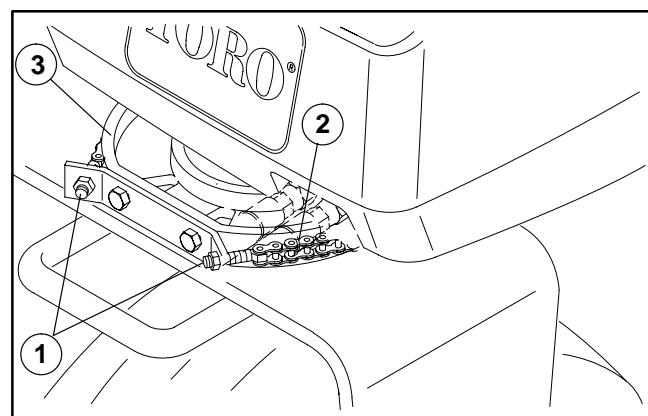


Figure 2

1. Lock nut 2. Chain 3. Chain guide

Adjust Brake (SP 2020/3020)



CAUTION

Before and after adjusting the brakes, always check the brakes in a wide open area that is flat and free of other persons and obstructions.

1. While driving the machine, pull brake lever. Both wheels should lock equally.
2. Park machine on a level surface, turn engine off, and block wheels.
3. Loosen jam nut on actuator rod. Remove cotter pin securing actuator rod traverse rod lever. Increase or decrease actuator rod length by rotating rod. Reinstall actuator rod using a new cotter pin. Secure jam nut.
4. Loosen set screw on the brake lever. Adjust travel of brake lever as follows: turn adjustment knob clockwise to shorten lever travel, turn adjustment knob counterclockwise to lengthen lever travel. Tighten set screw.
5. Drive the machine and pull brake lever. Both wheels should lock equally. Readjust brake if necessary.

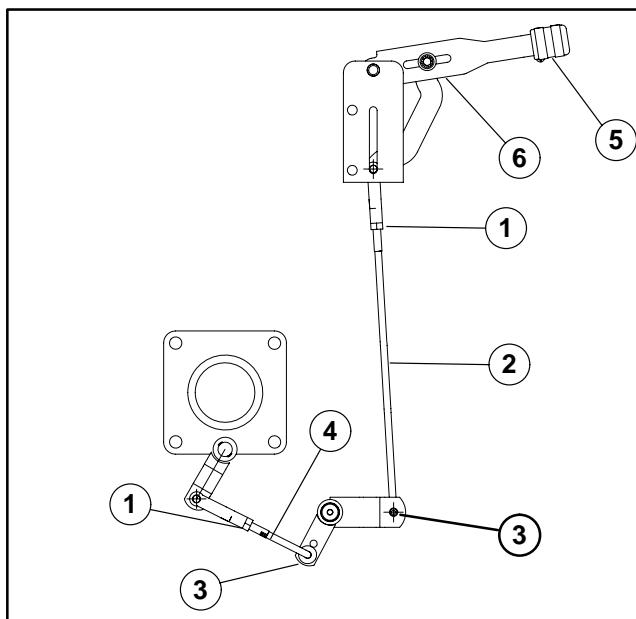


Figure 3

- | | |
|-----------------|--------------------|
| 1. Jam nut | 4. Adjustment rod |
| 2. Actuator rod | 5. Adjustment knob |
| 3. Cotter pin | 6. Brake lever |

Adjust Brake (SP 5020)



CAUTION

Before and after adjusting the brakes, always check the brakes in a wide open area that is flat and free of other persons and obstructions.

1. While driving the machine, pull brake lever. Both wheels should lock equally.
2. Park machine on a level surface, turn engine off, and block wheels.
3. Loosen jam nut on the adjustment rod.
4. Remove cotter pin and clevis pin securing the adjustment clevis to the brake arm.
5. Increase or decrease adjustment rod length by rotating the clevis. Reinstall adjusting rod clevis with clevis pin and new cotter pin. Secure jam nut.
6. Repeat procedure on the opposite adjustment rod clevis.

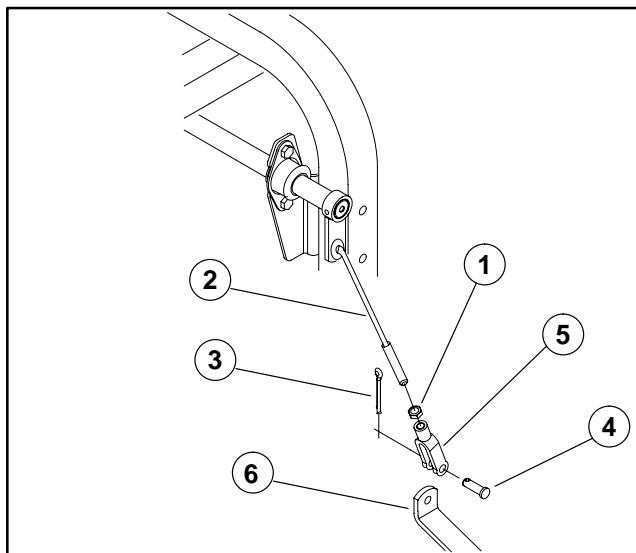


Figure 4

- | | |
|-------------------|----------------------|
| 1. Jam nut | 4. Clevis pin |
| 2. Adjustment rod | 5. Adjustment clevis |
| 3. Cotter pin | 6. Brake arm |

7. Drive the machine and pull brake lever. Both wheels should lock equally. Readjust brake if necessary.

Service and Repairs

Seat (SP 2020/3020)

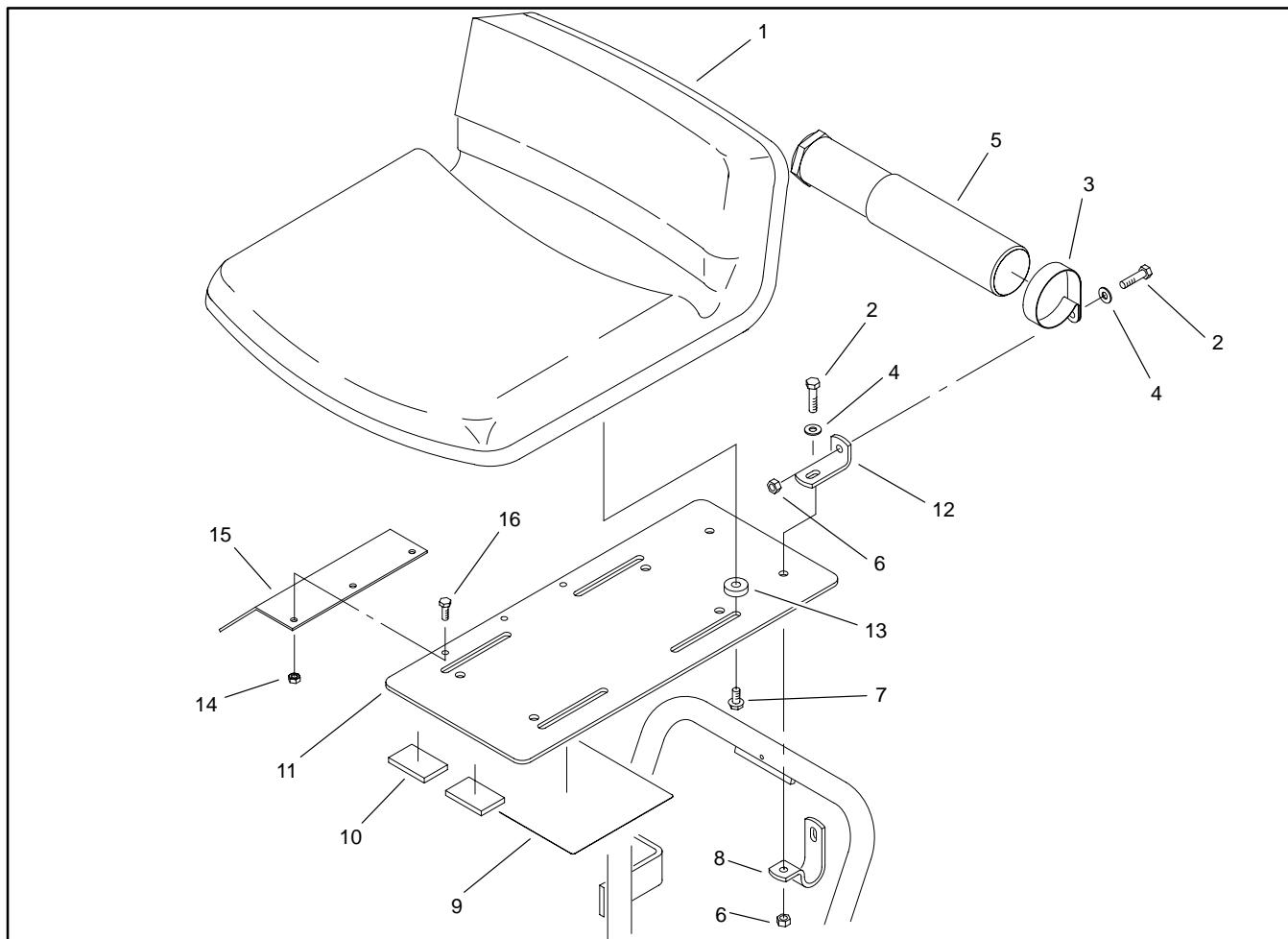


Figure 5

- 1. Seat
- 2. Cap screw
- 3. R-clamp
- 4. Flat washer
- 5. Manual tube
- 6. lock nut

- 7. Cap screw
- 8. Seat clamp
- 9. Service decal
- 10. Rubber cushion
- 11. Seat plate

- 12. Angle bracket
- 13. Spacer
- 14. Lock nut
- 15. Seat base shield
- 16. Cap screw

Removal

1. Park machine on a level surface, engage the parking brake, lower attachment, and stop engine.
2. Lift seat up. Remove four cap screws from seat plate and seat. Separate seat from plate. Make sure not to lose four spacers.
3. Remove seat plate from frame by removing lock nuts, cap screws and flat washers from the angle brackets and seat clamps.

Installation

1. Install seat plate to frame by securing plate to angle brackets and seat clamps with cap screws, flat washers, and lock nuts. Secure manual tube and R-clamps to angle bracket with cap screws, flat washers, and lock nuts.
2. Position seat and spacers to seat plate. Insert cap screws through plate and spacers. Screw cap screws into seat and tighten.
3. Replace rubber cushions if worn or damaged.

Front Wheel (SP 2020)

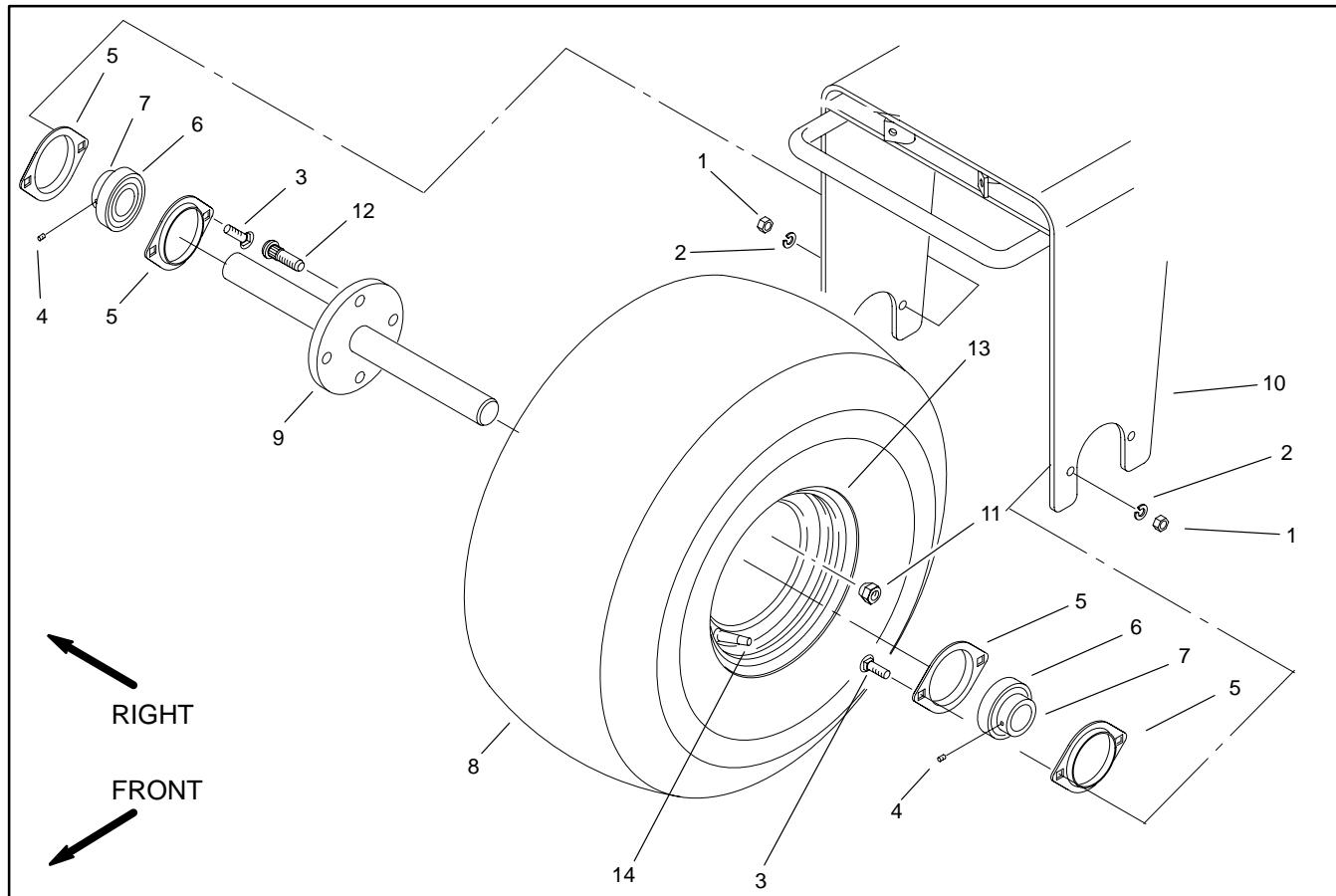


Figure 6

- 1. Hex nut
- 2. Lock washer
- 3. Carriage bolt
- 4. Set screw
- 5. Bearing flange

- 6. Bearing
- 7. Locking collar
- 8. Tire
- 9. Front axle
- 10. Front fork

- 11. Lug nut
- 12. Drive stud
- 13. Wheel rim
- 14. Valve stem

Removal (Fig. 6)

1. Park machine on a level surface, engage parking brake, lower attachment, and stop the engine.



WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

2. Jack up front fork enough to allow the bearing flanges and front axle to drop free of the fork.
3. Loosen set screws on both locking collars; Unlock collar by turning against the direction of shaft rotation.
4. Remove hex nuts and lock washers from carriage bolts securing the bearing flanges to the front fork.



CAUTION

Support wheel and shaft when removing carriage bolts from the front fork and bearing flanges to prevent personal injury.

5. Remove carriage bolts from bearing flanges and front fork. Lower front wheel from fork.
6. Slide bearing flanges and bearings off the front axle.
7. Separate bearing flanges from the bearings.
8. Remove lug nuts from the drive studs. Separate front axle from wheel rim.

Installation (Fig. 6)

1. Position front axle and drive studs through the wheel rim. Secure axle to rim with lug nuts to studs. Torque nuts from 45 to 55 ft-lb (6.2 to 7.6 kg-m).
2. Place bearing between two bearing flanges. Slide assembly onto axle with the locking collar facing away from the wheel. Repeat with remaining bearing and flanges on the other end of the axle.
3. Position wheel to the front fork. Make sure bearing flanges are placed inside the fork.
4. Secure bearing flanges to the front fork with carriage bolts, lock washers, and hex nuts.
5. Rotate both bearing lock collars in the direction of normal forward wheel rotation. Place drift punch into the blind hole of the locking collar. Strike punch sharply with a hammer in the direction of shaft rotation to lock the collar. Repeat with other collar.
6. Apply Loctite 242 or equivalent to both set screws. Secure locking collars with set screws. Torque set screws from 65 to 80 in-lb (74.9 to 92.2 kg-cm).
7. Lower front wheel to ground.

Front Wheel (SP 3020 and SP 5020)

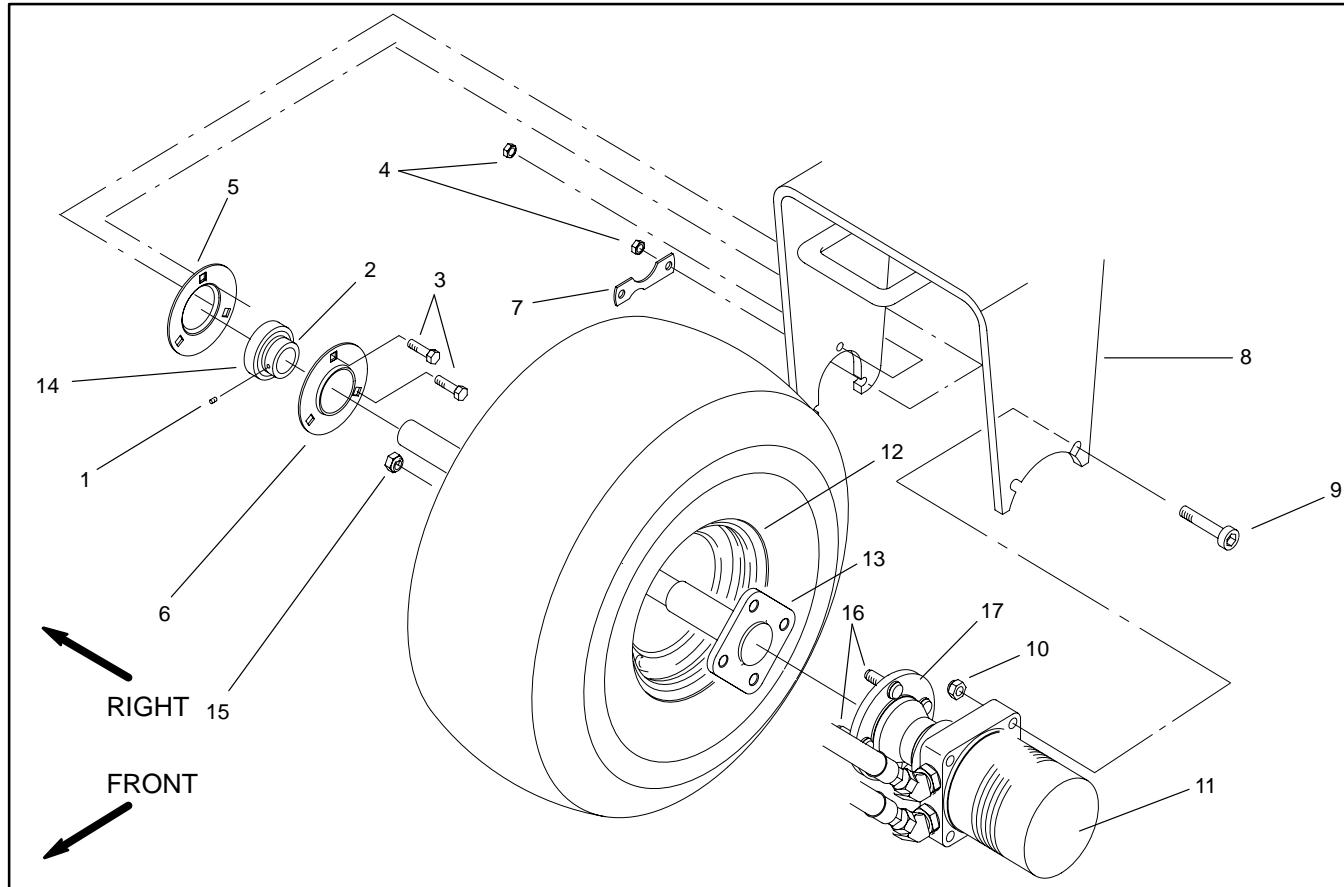


Figure 7

- | | | |
|---------------------|----------------------|----------------|
| 1. Set screw | 7. Bearing tab | 13. Spindle |
| 2. Locking collar | 8. Front fork | 14. Bearing |
| 3. Cap screw | 9. Socket head screw | 15. Lug nut |
| 4. Lock nut | 10. Lock nut | 16. Drive stud |
| 5. Relube flangette | 11. Hydraulic motor | 17. Wheel hub |
| 6. Flangette | 12. Front wheel | |

NOTE: The front wheel motors and wheels on the **SP 3020** and **SP 5020** are attached to the front fork in the same manner. Therefore the same procedures can be used for removal and installation.

Removal (Fig. 7)

1. Park machine on a level surface, engage parking brake, lower attachment, and stop the engine.
2. Loosen both set screws on the locking collar.
3. Support front of the machine. Remove three cap screws and lock nuts securing the flangettes and bearing tab to the fork.
4. Remove both socket head screws and lock nuts securing the hydraulic motor to the fork.

IMPORTANT: Support wheel and motor when jacking up the front fork to prevent dropping and damaging the motor.



WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

5. Jack up fork slowly until the hydraulic motor and flangettes can be removed from the fork. Remove flangettes, spindle, wheel, and motor from the fork.
6. Slide flangettes and bearing assembly from the spindle. Separate flangettes from the bearing.
7. Remove four lug nuts from the drive studs. Remove wheel from the drive studs and spindle. Separate spindle from drive studs and wheel hub.
8. Secure hydraulic motor and hub to the machine to prevent damaging the hydraulic lines.

- If the wheel hub needs replacing, remove hydraulic motor from hydraulic lines, and remove hub from motor (see Front Wheel Removal in Chapter 4 – Hydraulic Systems).

Installation (Fig. 7)

- If the wheel hub was removed from the hydraulic motor, install hub to motor, and install hydraulic motor to hydraulic lines (see Front Wheel Installation in Chapter 4 – Hydraulic Systems).
- Position hydraulic motor and hub to the front fork.
- Install spindle to drive studs and wheel hub. Insert spindle and drive studs through wheel. Make sure valve stem and hydraulic motor are on the opposite sides of the wheel.
- Secure lug nuts to drive studs. Torque nuts from 45 to 55 ft-lb (6.2 to 7.6 kg-m).

- Slide flanette and bearing assembly onto the spindle shaft so the locking collar faces the wheel.

- Position hydraulic motor, wheel, and flanettes to the front fork.

- Lower front fork slowly. Make sure flanettes and front wheel motor fit snugly into the fork.

- A. Secure flanettes to the fork with cap screws, bearing tab, and locknuts.

- B. Secure hydraulic motor to the front fork with socket head screws and lock nuts.

8. Lower fork completely. Make sure flanette and hydraulic motor are positioned correctly into the fork. Tighten fasteners properly.

9. Apply Loctite 242 or equivalent to both set screws. Install set screws to locking collar. Torque set screws from 65 to 80 in-lb (74.9 to 92.2 kg-cm).

Rear Wheels and Brakes

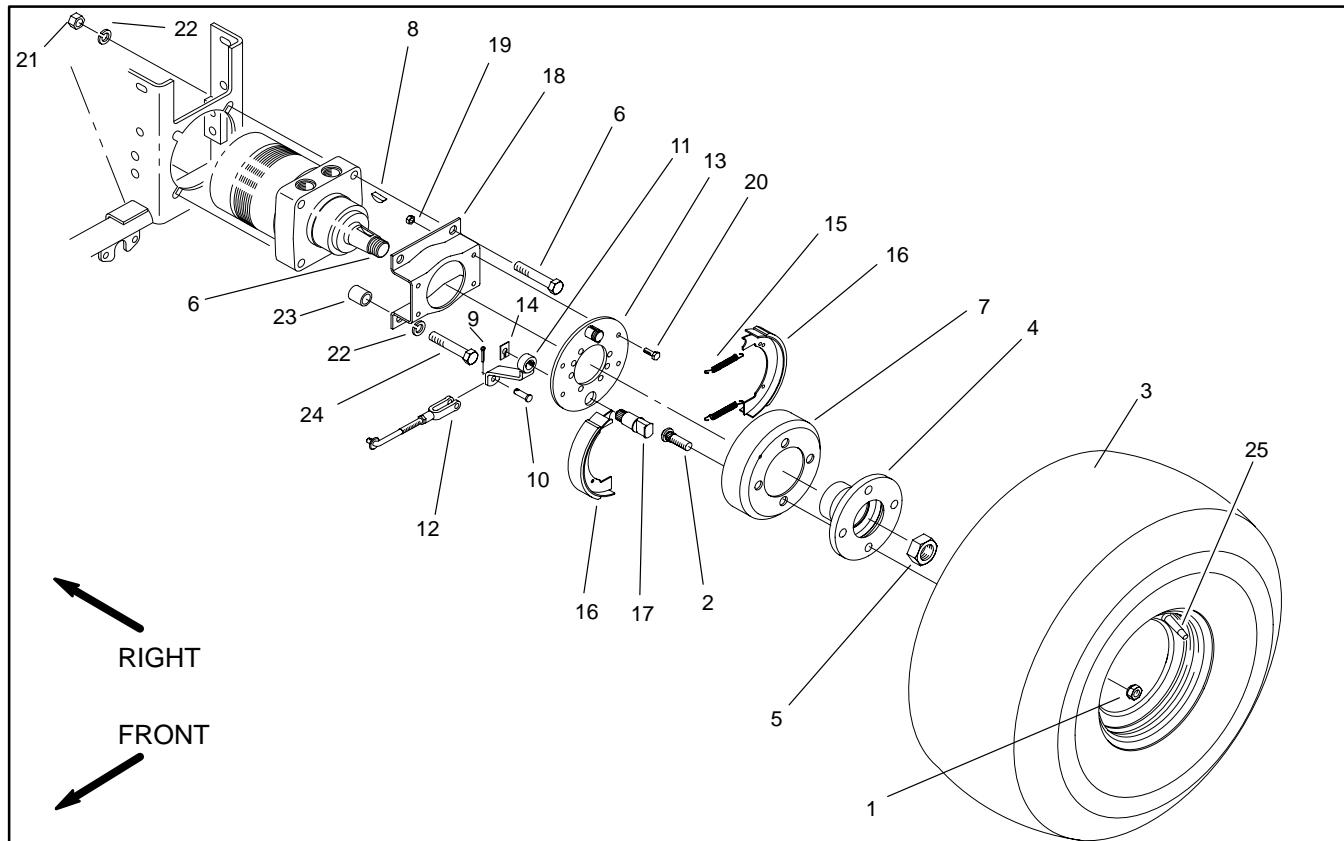


Figure 8

- | | | |
|-----------------|--------------------|-------------------|
| 1. Lug nut | 10. Clevis pin | 18. Brake bracket |
| 2. Drive stud | 11. Brake lever | 19. Lock nut |
| 3. Wheel | 12. Clevis | 20. Cap screw |
| 4. Hub | 13. Backing plate | 21. Hex nut |
| 5. Lock nut | 14. Retaining clip | 22. Lock washer |
| 6. Motor shaft | 15. Return spring | 23. Spacer |
| 7. Brake drum | 16. Brake shoe | 24. Cap screw |
| 8. Woodruff key | 17. Cam shaft | 25. Valve stem |
| 9. Cotter pin | | |

Removal (Fig. 8)

NOTE: The rear wheels and brakes on The **SP 2020/3020** and **SP 5020** are identical in construction. The same procedures can be used for repair and maintenance of either machine.

- Park machine on a level surface, lower attachment, and stop engine.



WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

- Jack up rear wheel and use wood blocks to keep the rear tire off the floor.

- Remove lug nuts from drive studs. Pull wheel from drive studs and wheel hub.

NOTE: The installation torque of the locknut is from 200 to 400 ft-lb (27.7 to 55.3 kg-cm). Use impact wrench to remove lock nut from the hydraulic motor shaft.

- Apply parking brake Remove lock nut from the hydraulic motor shaft. Release parking brake.

IMPORTANT: Do not hit wheel hub with a hammer during removal or installation. Hammering may cause damage to the hydraulic wheel motor.

- Use puller to remove wheel hub and brake drum from the hydraulic motor shaft. Remove woodruff key from the shaft.
- Remove cotter pin from clevis pin. Remove clevis pin from brake lever and clevis. Separate clevis from brake lever.

NOTE: The brake lever, backing plate, retaining clip, return springs, brake shoes, and cam shaft can be removed as a complete brake assembly.

7. If it is desired to remove the brake assembly from the brake bracket, remove four cap screws and lock nuts securing the assembly to the bracket.

8. Disassemble brake assembly as follows (Fig. 9):

A. Remove return springs from the brake shoes. Remove brake shoes from the backing plate.

B. Matchmark brake cam and brake lever to assure proper alignment during reassembly. Remove retaining clip from the brake cam. Pull brake lever from the cam. Remove cam from backing plate.

9. The brake bracket can be removed as follows:

A. Remove hex nuts, lock washers, spacers, and cap screws securing the brake bracket and hydraulic motor to the frame.

B. Separate bracket from the frame.

Installation (Fig. 8)

1. Secure brake bracket and hydraulic motor to the frame as follows:

A. On the top two holes, insert cap screws through bracket, spacers, motor and frame. Secure with lock washers and hex nuts, but do not tighten

B. On the bottom two holes, insert cap screws through lock washers, bracket, spacers, motor and frame. Secure with hex nuts, but do not tighten

2. Assemble brake assembly as follows (Fig. 9):

A. Secure backing plate to the brake bracket with four cap screws and lock washers.

B. Apply antiseize lubricant to cam shaft splines. Insert cam shaft through the backing plate.

C. Attach brake lever to the cam shaft. Make sure matchmarks are aligned properly. Secure lever to shaft with retaining clip.

D. Position both brake shoes on the backing plate so that the concave heels attach to the anchor pin.

E. Insert both return springs into the holes of both brake shoes. Make sure shoes fit snuggly against the anchor pin and cam.

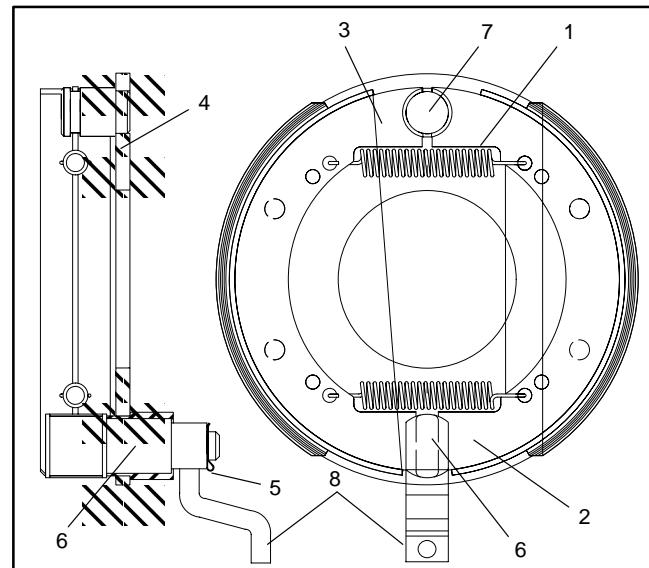


Figure 9

- | | |
|--------------------------|-------------------|
| 1. Return spring | 5. Retaining clip |
| 2. Brake shoe (toe end) | 6. Cam shaft |
| 3. Brake shoe (heel end) | 7. Anchor pin |
| 4. Backing plate | 8. Brake lever |

3. If the brake lever, backing plate, retaining clip, return springs, brake shoes, and cam shaft were removed as a complete brake assembly, secure backing plate to the brake bracket with four cap screws and lock washers. Tighten fasteners.

4. Attach clevis to brake lever. Insert clevis pin through clevis and brake lever. Secure clevis pin with cotter pin.

5. Place antiseize lubricant on woodruff key. Install key to the slot on the hydraulic motor shaft. Slide wheel hub and brake drum assembly onto the shaft.

6. Secure wheel hub and brake drum to the hydraulic motor shaft with lock nut.

NOTE: The brake shoes and backing plate must be concentrically aligned with the brake drum. This will prevent the shoes from dragging on the drum when the brakes are released.

7. Apply parking brake. Tighten four cap screws and hex nuts securing the brake bracket to the hydraulic motor and frame. Torque lock nut from 200 to 400 ft-lb (27.7 to 55.3 kg-m). Release parking brake.

8. Place wheel onto drive studs and wheel hub. Secure wheel with lug nuts on drive studs. Torque lug nuts from 45 to 55 ft-lb (6.2 to 7.6 kg-m) in a criss-cross pattern.

9. Lower wheel to ground.

10. Check and adjust brakes (see Adjust Brake).

Brake Linkages (SP 2020/3020)

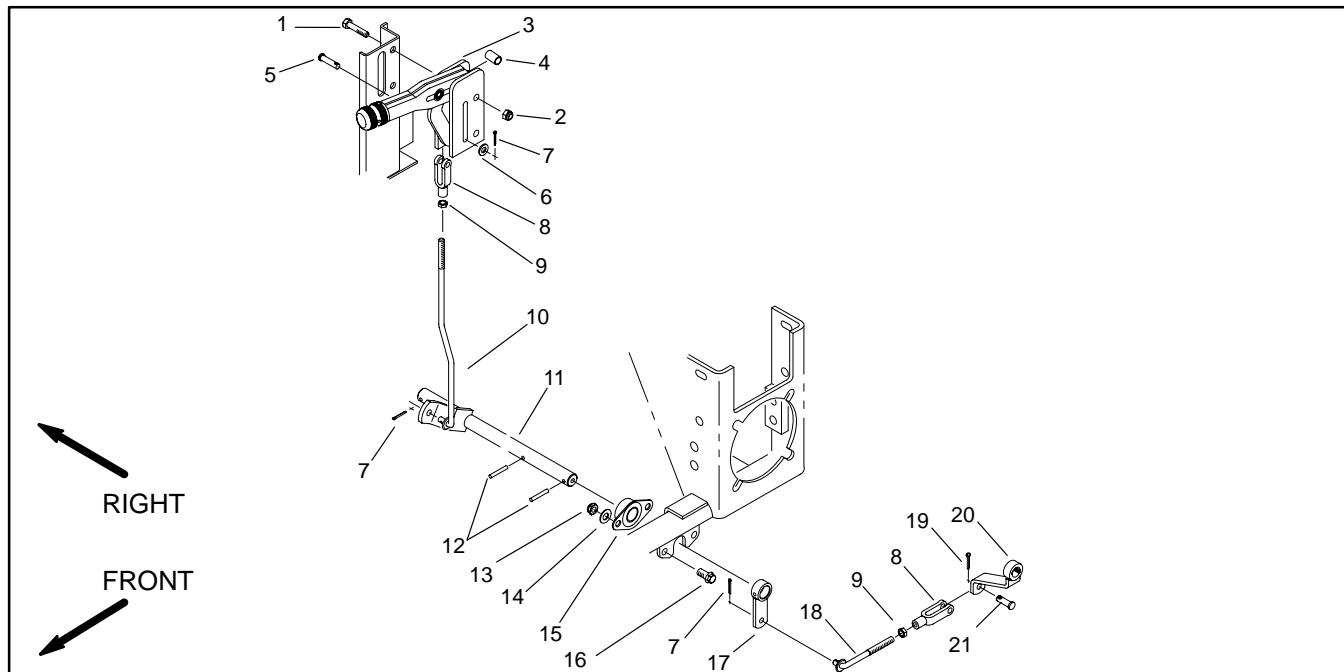


Figure 10

- | | | |
|----------------|-------------------|-------------------------------------|
| 1. Cap screw | 8. Clevis | 15. Side flange bearing |
| 2. Lock nut | 9. Jam nut | 16. Cap screw |
| 3. Brake lever | 10. Brake rod | 17. Brake arm |
| 4. Spacer | 11. Adjusting rod | 18. Adjusting rod |
| 5. Clevis pin | 12. Roll pins | 19. Cotter pin |
| 6. Flat washer | 13. Spacer | 20. Brake lever (to brake assembly) |
| 7. Cotter pin | 14. Flat washer | 21. Clevis pin |

Most parking brake linkage parts can be repaired or replaced without removing any interference. However, the lift valve shroud must be removed to work on the parking brake lever.



CAUTION

The muffler and exhaust pipe may be hot. Avoid possible burns; allow engine and exhaust system to cool before working near muffler.

1. Remove knob from the lift lever. Remove both lock nuts and cap screws securing the lift valve shroud, lift lever guide, and lift lever latch (Fig. 26).
2. Remove bottom front cap screw securing the lift valve shroud to the frame. Pull shroud from the frame (Fig. 26).

IMPORTANT: When removing the clevis from either the brake rod or brake lever or the brake lever from the cam shaft on the brake assembly, make sure to matchmark both parts. Marking both parts will make reassembly and brake adjustment easier.

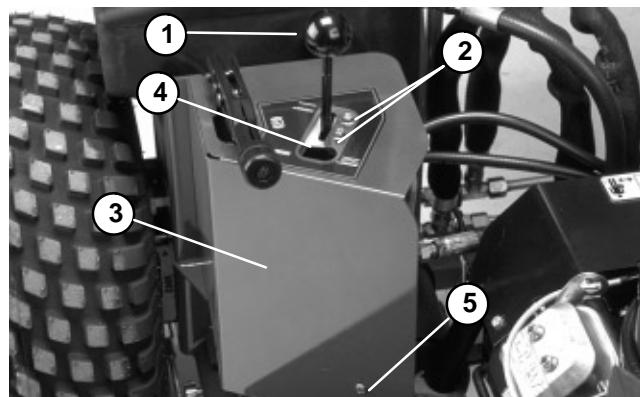


Figure 11

- | | |
|-------------------------|-----------------------------|
| 1. Knob | 4. Lift lever guide & latch |
| 2. Lock nut & cap screw | 5. Cap screw |
| 3. Lift valve shroud | |
3. Remove and replace parts as necessary to repair brake linkages (Fig. 10).
 4. Reinstall lift lever latch, lift lever guide, lift valve shroud, and knob (Fig. 26).
- IMPORTANT:** Always check and adjust the brakes anytime brake linkages are disassembled or repaired (see Brake Adjustment).

Brake Linkages (SP 5020)

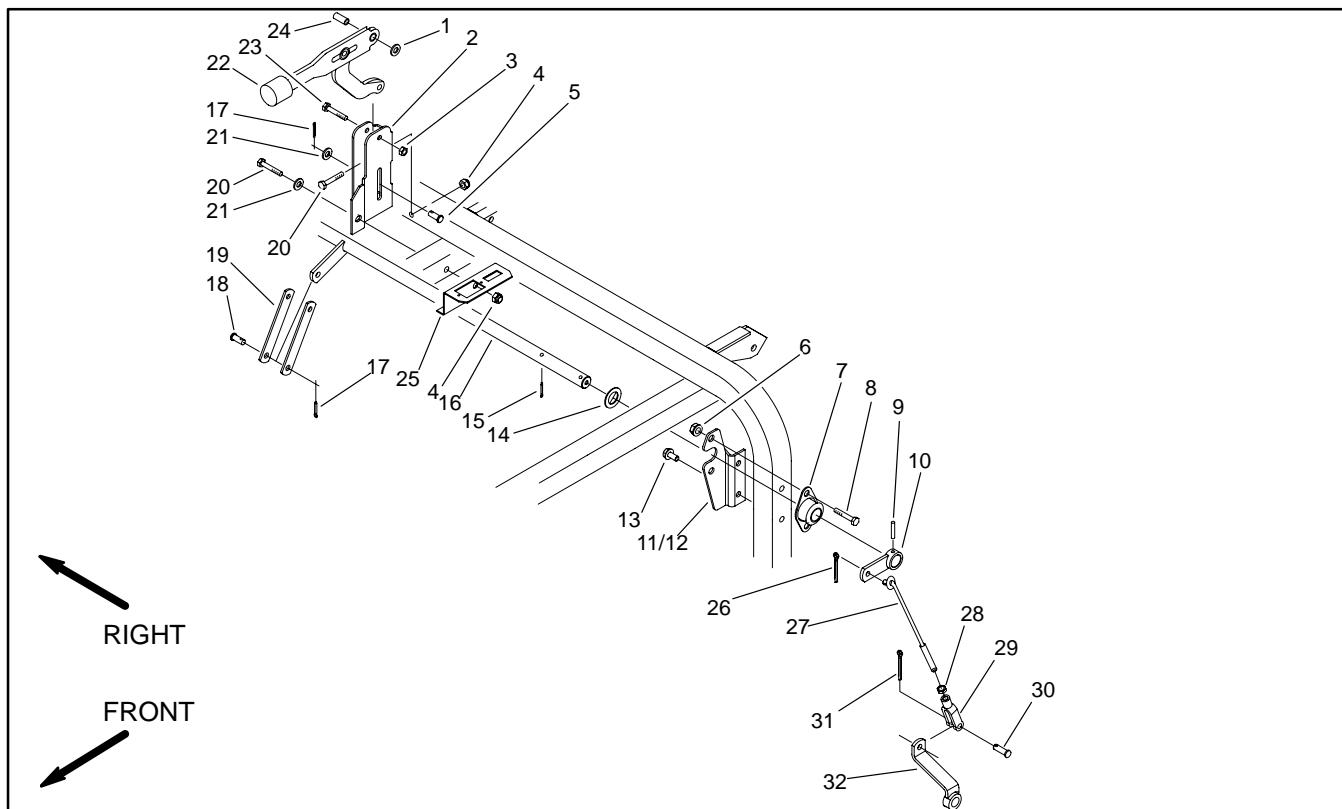


Figure 12

1. Curved washer
2. Lever bracket
3. Lock nut
4. Lock nut
5. Clevis pin
6. Lock nut
7. Side flange bearing
8. Hex head flange
9. Roll pin
10. Brake arm
11. Left bearing bracket

12. Right bearing bracket
13. Washer head screw
14. Flat washer
15. Cotter pin
16. Traverse rod
17. Cotter Pin
18. Clevis pin
19. Strap
20. Cap screw
21. Flat washer
22. Lever assembly

23. Cap screw
24. Spacer
25. Hourmeter bracket
26. Cotter pin
27. Adjustment rod
28. Jam nut
29. Adjustment clevis
30. Clevis pin
31. Cotter pin
32. Brake lever

Most parking brake linkage parts can be repaired or replaced without removing any interference. However, the right fender must be removed to work on the parking brake lever.

IMPORTANT: Make sure to matchmark both parts when removing the clevis from either the brake rod or brake lever or removing the brake lever from the cam shaft on the brake assembly. Marking both parts will make reassembly and brake adjustment easier.

2. Remove and replace parts as necessary to repair brake linkages (Fig. 12).
3. Reinstall right fender if necessary (see Right Fender Installation).



CAUTION

The muffler and exhaust pipe may be hot. Avoid possible burns; allow engine and exhaust system to cool before working near the muffler.

1. Remove right fender if necessary (see Right Fender Removal).

IMPORTANT: Always check and adjust the brakes anytime brake linkages are disassembled or repaired (see Brake Adjustment).

Front Fork and Steering (SP 2020 and Older SP 3020 Models)

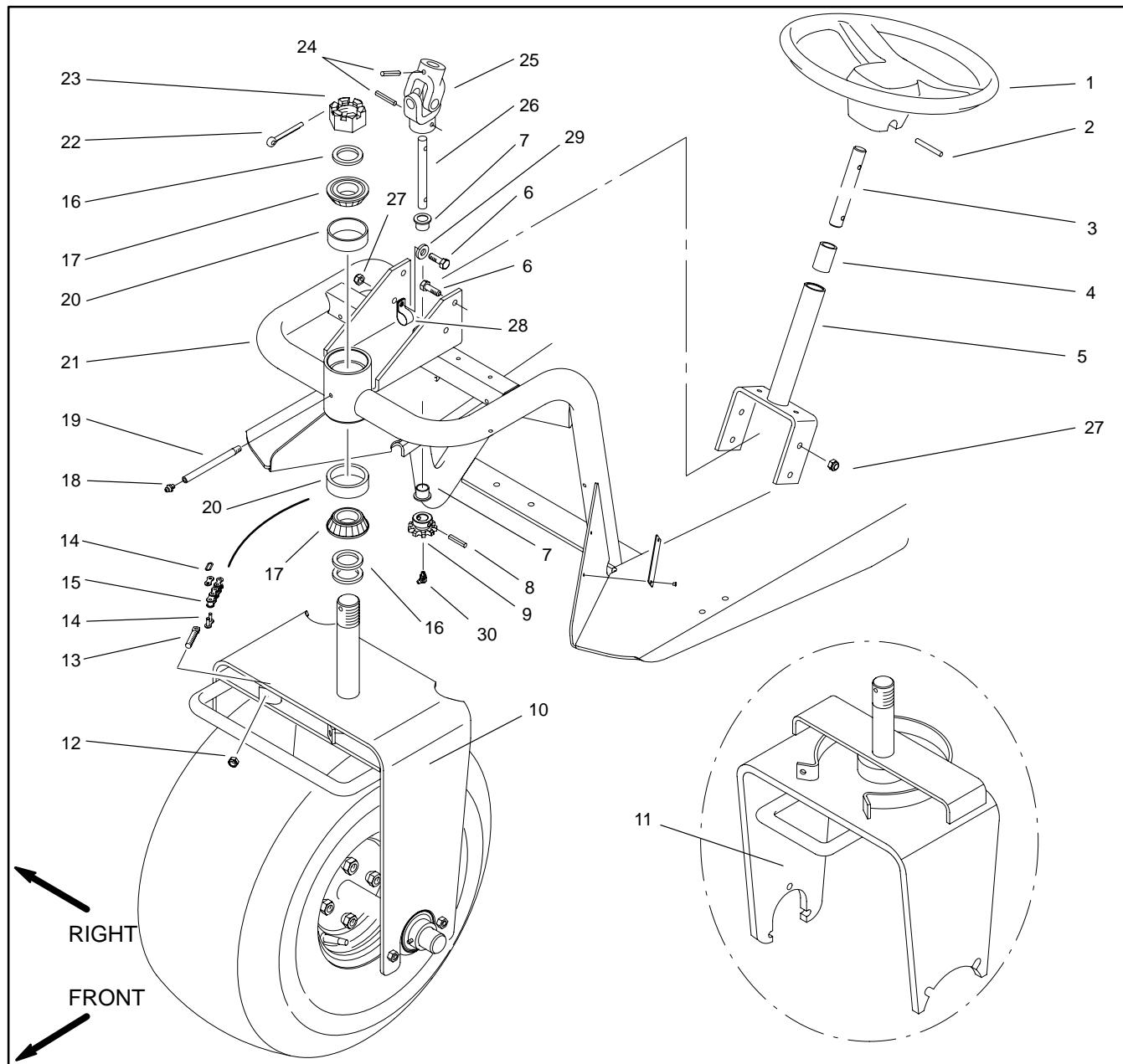


Figure 13

- | | | |
|--------------------------|---------------------------------------|-------------------------------|
| 1. Steering wheel | 11. Front fork (SP 3020 older models) | 21. Frame |
| 2. Roll pin | 12. Lock nut | 22. Cotter pin |
| 3. Upper steering shaft | 13. Steering adjustment pin | 23. Slotted nut |
| 4. Sleeve bushing | 14. Connecting link | 24. Roll pin |
| 5. Steering post | 15. Steering chain | 25. Steering knuckle |
| 6. Cap screw | 16. Steering washer | 26. Lower steering shaft |
| 7. Flange bushing | 17. Bearing cone | 27. Lock nut |
| 8. Drive-lock pin | 18. Grease fitting (see NOTE) | 28. R-clamp |
| 9. Sprocket | 19. Extension tube (see NOTE) | 29. Washer |
| 10. Front fork (SP 2020) | 20. Bearing cup | 30. Grease fitting (see NOTE) |

NOTE: On newer models of the **SP 2020**, grease fitting (18) and extension tube (19) are not installed. Grease fitting (30) is installed on newer models of the **SP 2020**.

Front Fork and Steering (Newer SP 3020 Models)

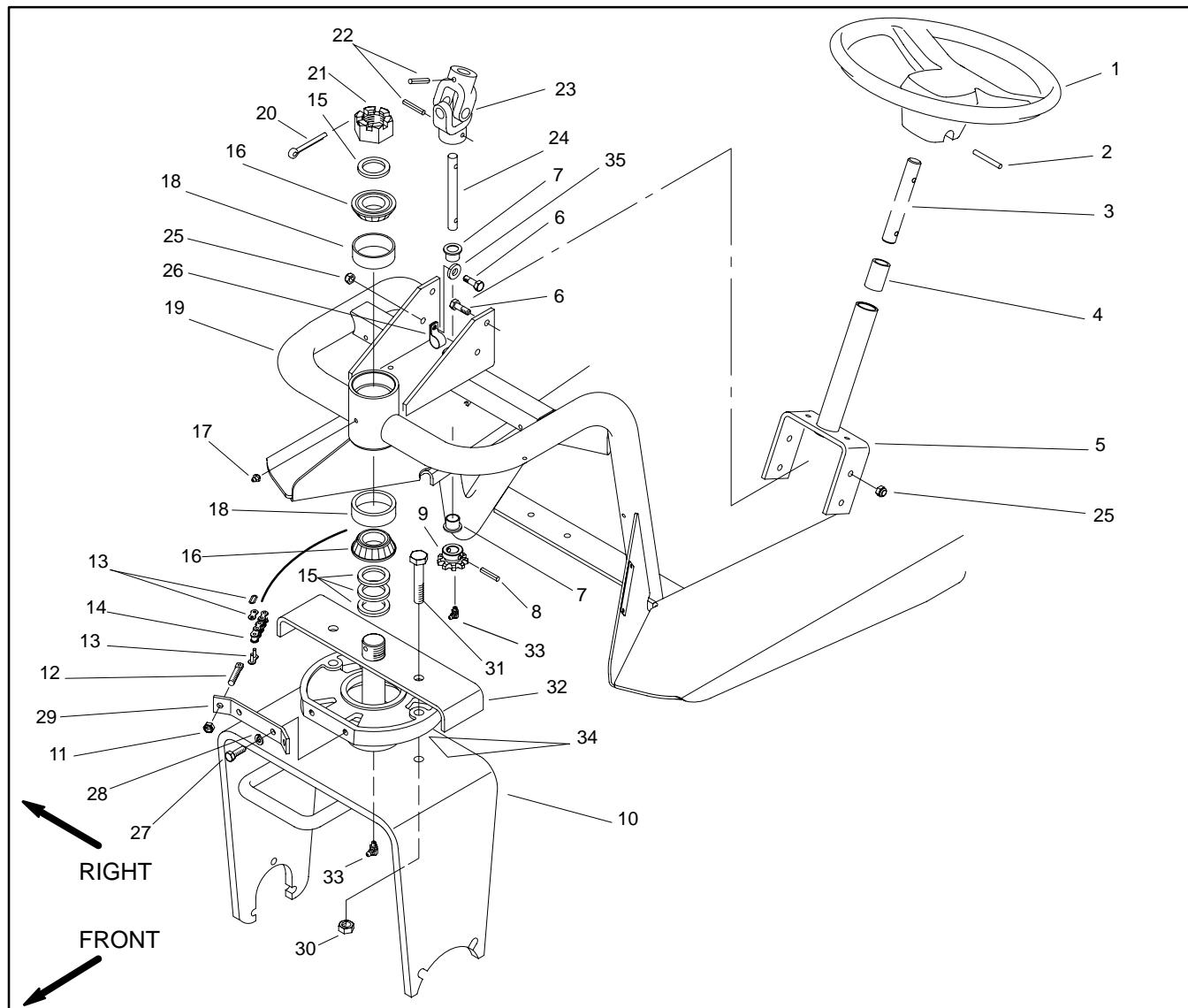


Figure 14

- | | | |
|-----------------------------|--------------------------|---------------------|
| 1. Steering wheel | 13. Connecting link | 25. Lock nut |
| 2. Roll pin | 14. Steering chain | 26. R-clamp |
| 3. Upper steering shaft | 15. Steering washer | 27. Cap screw |
| 4. Sleeve bushing | 16. Bearing cone | 28. Lock washer |
| 5. Steering post | 17. Grease fitting | 29. Chain bracket |
| 6. Cap screw | 18. Bearing cup | 30. Hex nut |
| 7. Flange bushing | 19. Frame | 31. Cap screw |
| 8. Drive-lock pin | 20. Cotter pin | 32. Fork stop plate |
| 9. Sprocket | 21. Slotted nut | 33. Grease fitting |
| 10. Front fork | 22. Roll pins | 34. Chain guide |
| 11. Lock nut | 23. Steering knuckle | 35. Washer |
| 12. Steering adjustment pin | 24. Lower steering shaft | |

Upper Steering Disassembly (Fig. 13 and 14)

NOTE: The front fork and steering assemblies on the **SP 2020** and **SP 3020** are almost identical. However, there are differences in the construction of the front fork, chain guide, chain bracket, and the number of steering washers.

1. Park machine on a level surface, lower attachment, stop engine, engage parking brake, and remove key from the ignition switch.
2. Remove hood from the dash panel and machine (see Hood and Dash Panel Removal).

NOTE: The starter solenoid must be removed from the frame to allow separation of the **upper** and **lower** steering shafts from the steering knuckle. Removal is **not** required for removal of the front fork.

3. Remove black (negative) cable from the battery.
4. Disconnect starter wire and battery cable from the starter solenoid. Remove self tapping screws from the solenoid and frame. Position solenoid away from the steering knuckle (Fig. 15).

NOTE: If disassembly **above** the steering knuckle is required, use the following procedure.

5. Drive out roll pin securing upper steering shaft to steering knuckle with drift punch.
6. If it is required to remove the steering knuckle at this time, drive out roll pin securing the lower steering shaft to steering knuckle with drift punch.
7. Pull upper steering shaft from steering post and steering knuckle. If desired, pull steering knuckle from the lower steering shaft.
8. Remove both hex flange head screws securing the dash panel to the steering post (Fig. 16).
9. Remove four lock nuts and cap screws securing both R-clamps and steering post to the frame (Fig. 15).
10. Pull dash panel up and back. Slide steering post from dash panel.

Upper Steering Assembly (Fig. 13 and 14)

1. Position steering post through the dash panel and to the frame. Secure post and both R-clamps to the frame with four cap screws and lock nuts (Fig. 15).
2. Secure dash panel to the steering post with both hex flange head screws (Fig. 16).
3. If removed, install steering knuckle onto the lower steering shaft with roll pin.

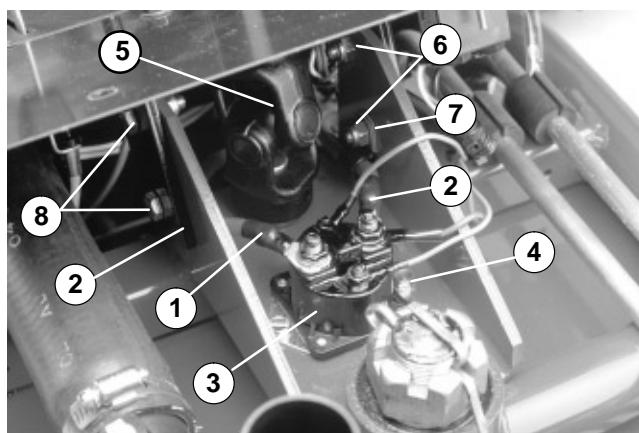


Figure 15

- | | |
|-----------------------|---------------------|
| 1. Starter wire | 5. Steering knuckle |
| 2. Battery cable | 6. Lock nut |
| 3. Starter solenoid | 7. R-clamp |
| 4. Self tapping screw | 8. Cap screw |



Figure 16

1. Hex flange head screws
2. Dash panel
3. Steering post
4. Position upper steering shaft down through the steering post into the steering knuckle. Align holes of the shaft and steering knuckle and secure with roll pin.
5. Secure solenoid to the frame with self tapping screws. Connect starter wire and battery cable to the starter solenoid (Fig. 15).
6. Install hood to the dash panel and machine (see Hood and Dash Panel Installation).
7. Install black (negative) cable to the battery.

Lower Steering Disassembly (Fig. 13 and 14)

NOTE: If disassembly of the steering mechanism **below** the steering knuckle is required, proceed as follows:

1. Loosen lock nut on the steering adjustment pin enough to loosen the steering chain from the sprocket. Remove chain from sprocket.
2. Remove drive-lock pin from the sprocket and lower steering shaft with drift punch (Fig. 17).
3. Drive out roll pin securing lower steering shaft to steering knuckle with drift punch.
4. If it is required to remove the steering knuckle at this time, drive out roll pin securing upper steering shaft to the steering knuckle with drift punch.
5. Pull lower steering shaft from the frame and steering knuckle. If required, pull steering knuckle from the upper steering shaft.

Lower Steering Assembly (Fig. 13 and 14)

1. If removed, secure steering knuckle to the upper steering shaft with roll pin.
2. Position lower steering shaft through the frame and into the steering knuckle. Align holes and secure shaft to the steering knuckle with roll pin.

IMPORTANT: Drive-lock pins are not reusable. Always replace removed pin with a new pin.

3. Secure sprocket to the lower steering shaft with **new** drive-lock pin (Fig. 17).
4. Position steering chain around the sprocket and chain guide. Secure chain to chain bracket with steering adjustment pins and lock nuts. Adjust steering chain (see Adjust Steering Chain).

Front Fork Removal (Fig. 13 and 14)

NOTE: If disassembly of the front fork and its bearings is required, proceed as follows:



WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

1. Jack up front wheel enough to allow removal of the front fork.
2. Remove cotter pin securing the slotted nut to the fork shaft. Unscrew slotted nut from the shaft. Remove steering washer from the shaft.

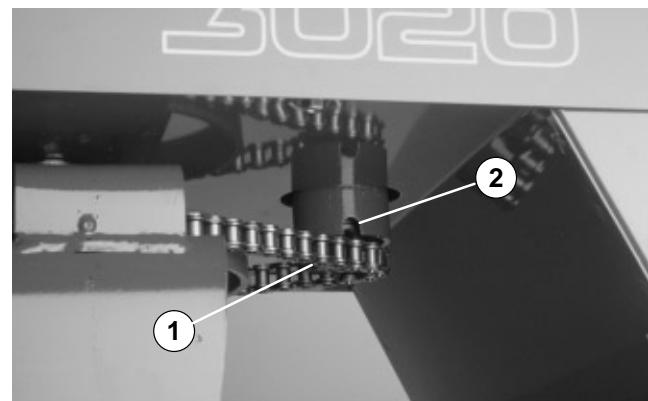


Figure 17

1. Sprocket

2. Drive-lock pin

3. Pull fork from the frame. Remove upper bearing cone from the frame.
4. Remove lock nut from each adjustment pin. Remove steering chain from front fork and sprocket.
5. Remove front wheel from the front fork (see Front Wheel Removal).



CAUTION

Support front fork to prevent its falling during removal. Personal injury or damage to the fork may result from improper handling.

NOTE: If it is necessary to pry the fork from the frame, make sure even pressure is apply to both sides of the fork to prevent damaging the bearing cone and cup.

6. Inspect bearing cups and cones for damage. Replace bearings if necessary.
7. On **newer models of the SP 3020**, the chain bracket and chain guide may be removed from the front fork if necessary.

Front Fork Installation (Fig. 13 and 14)

1. On **newer models of the SP 3020**, secure chain guide to the front fork with fork stop plate, cap screws, and hex nuts. Secure chain bracket to the chain guide with cap screws and lock washers.
2. If bearing cups were damaged, press **new** bearing cups into the frame.
3. If bearing cones were damaged, install bearing washers onto the shaft of the front fork. Install **new** bearing cop onto the shaft with bearing driver.

4. Position fork shaft up through frame. Install bearing cone and bearing washer onto the shaft. If bearing cones were damaged, install **new** bearing cone onto shaft.
5. Screw slotted nut onto the fork shaft until a slight drag is felt while rotating the fork. Back off nut so nearest slot aligns with cross hole in the shaft. Secure nut to shaft with cotter pin.
6. Install front wheel to the front fork (see Front Wheel Installation).
7. Position steering chain around the sprocket and chain guide. Secure chain to chain bracket with steering adjustment pins and lock nuts. Adjust steering chain (see Adjust Steering Chain).

Seat (SP 5020)

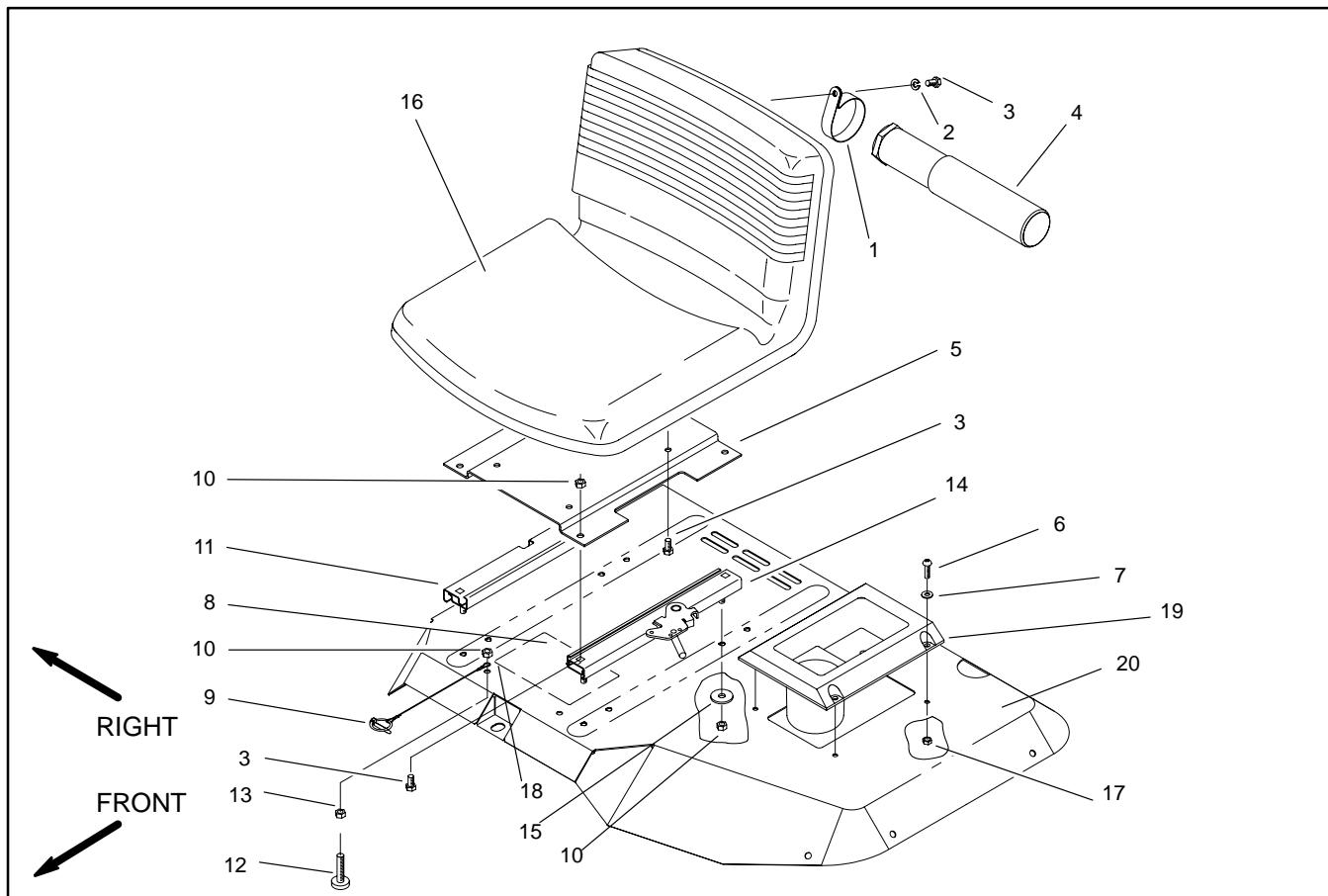


Figure 18

- 1. R-clamp
- 2. Lock washer
- 3. Cap screw
- 4. Manual tube
- 5. Seat adjust plate
- 6. Round head screw
- 7. Flat washer

- 8. Service decal
- 9. Lynch pin
- 10. Lock nut
- 11. 4-inch seat slider
- 12. Leveling screw
- 13. Jam nut
- 14. Seat slider

- 15. Flat washer
- 16. Seat
- 17. Lock nut
- 18. Flat washer
- 19. Cup holder
- 20. Seat base

Removal

1. Park machine on a level surface, engage the parking brake, lower attachment, and stop engine.
2. Slide seat all the way forward. Remove both cap screws and lock nuts securing the front of the seat adjust plate to the seat slider.
3. Slide seat all the way back. Remove both cap screws and lock nuts securing the rear of the seat adjust plate to the seat sliders.
4. Remove seat and seat adjust plate from the seat sliders. Remove four cap screws securing the seat adjust plate to the seat.
5. Lift seat base. Remove lock nuts and flat washers securing seat sliders to the seat base.

Installation

1. Lift seat base. Secure seat sliders to the seat base with flat washers and lock nuts.
2. Secure seat adjust plate to the seat with four cap screws.
3. Slide seat sliders all the way back. Position seat and seat adjust plate to the seat sliders. Secure rear of the seat adjust plate to the seat sliders with two cap screws and lock nuts.
4. Slide seat all the way forward. Secure front of the seat adjust plate to the seat sliders with two cap screws and lock nuts.
5. Make sure seat slides properly and locks in place.

Steering (SP 5020)

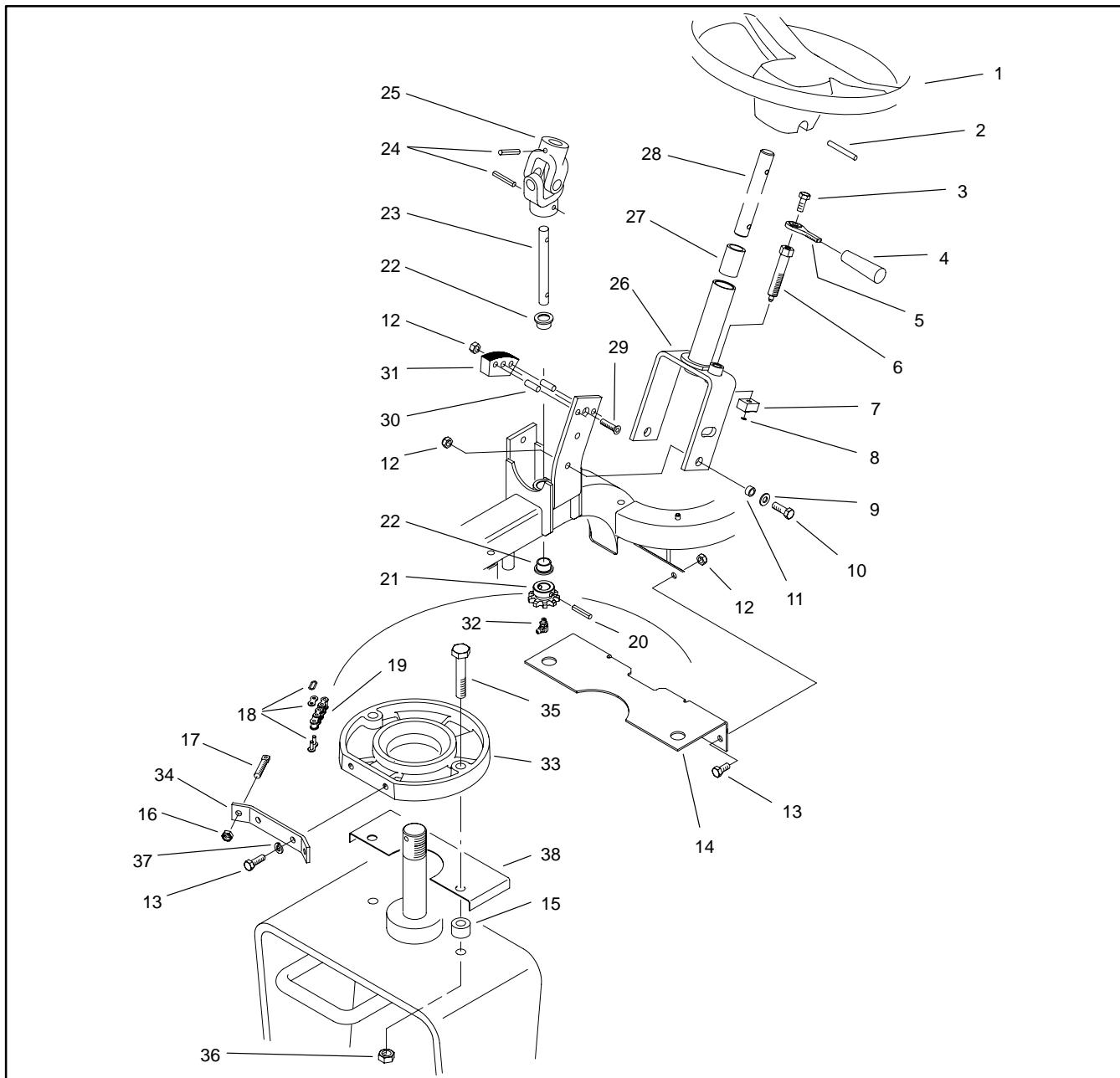


Figure 19

- | | | |
|--------------------------|--------------------------|----------------------------|
| 1. Steering wheel | 14. Fuel tank bracket | 27. Sleeve bushing |
| 2. Roll pin | 15. Spacer | 28. Upper steering shaft |
| 3. Cap screw | 16. Lock nut | 29. Flat head socket screw |
| 4. Handle | 17. Adjustment bolt | 30. Dowel |
| 5. Steering adjust lever | 18. Connecting link | 31. Lower lock block |
| 6. Tilt lock pin | 19. Chain | 32. Grease fitting |
| 7. Upper lock block | 20. Drive-lock pin | 33. Chain guide |
| 8. Retaining ring | 21. Sprocket | 34. Chain bracket |
| 9. Flat washer | 22. Flange bushing | 35. Cap screw |
| 10. Cap screw | 23. Lower steering shaft | 36. Hex nut |
| 11. Spacer | 24. Roll pin | 37. Lock washer |
| 12. Lock nut | 25. Steering knuckle | 38. Chain stay plate |
| 13. Cap screw | 26. Steering column | |

Upper Steering Disassembly (Fig. 19)

NOTE: If disassembly **above** the steering knuckle is required, use the following procedure.

1. Park machine on a level surface, lower attachment, stop engine, engage parking brake, and remove key from the ignition switch.

NOTE: The fuel tank must be removed from the frame to allow separation of the **upper** steering shafts from the steering knuckle.

2. Remove fuel tank from the machine (see Fuel Tank Removal in Chapter 3 – Briggs & Stratton Vanguard Engines).
3. Drive out roll pin securing upper steering shaft to steering knuckle with drift punch.
4. If it is required to remove the steering knuckle at this time, drive out roll pin securing the lower steering shaft to the steering knuckle with drift punch.
5. Pull upper steering shaft from steering column and steering knuckle. If desired, pull steering knuckle from the lower steering shaft.
6. Remove both lock nuts and cap screws securing both steering column to the frame.

Upper Steering Assembly (Fig. 19)

1. Secure steering column to the frame with both cap screws and lock nuts.
2. If removed, install steering knuckle onto the lower steering shaft with roll pin.
3. Position upper steering shaft down through the steering post into the steering knuckle. Align holes of the shaft and steering knuckle and secure with roll pin.
4. Install fuel tank to the machine (see Fuel Tank Installation in Chapter 3 – Briggs & Stratton Vanguard Engines).

Lower Steering Disassembly (Fig. 13 and 14)

NOTE: If disassembly of the steering mechanism **below** the steering knuckle is required, precede as follows:

1. Park machine on a level surface, lower attachment, stop engine, engage parking brake, and remove key from the ignition switch.

NOTE: The fuel tank must be removed from the frame to allow separation of the **lower** steering shafts from the steering knuckle.

2. Remove fuel tank from the machine (see Fuel Tank Removal in Chapter 3 – Briggs & Stratton Vanguard Engines).
3. Loosen lock nut on the steering adjustment bolt enough to allow the steering chain to come off the sprocket. Remove chain from sprocket.
4. Remove drive-lock pin from the sprocket and lower steering shaft with drift punch (Fig. 17).
5. Drive out roll pin securing lower steering shaft to steering knuckle with drift punch.
6. If it is required to remove the steering knuckle at this time, drive out roll pin securing upper steering shaft to the steering knuckle with drift punch.
7. Pull lower steering shaft from the frame and steering knuckle. If required, pull steering knuckle from the upper steering shaft.

Lower Steering Assembly (Fig. 13 and 14)

1. If removed, secure steering knuckle to the upper steering shaft with roll pin.
2. Position lower steering shaft through the frame and into the steering knuckle. Align holes and secure shaft to the steering knuckle with roll pin.

IMPORTANT: Drive-lock pins are not reusable. Always replace removed pin with a new pin.

3. Secure sprocket to the lower steering shaft with a new drive-lock pin.
4. Position steering chain around the sprocket and chain guide. Secure chain to chain bracket with steering adjustment pins and lock nuts. Adjust steering chain (see Adjust Steering Chain).
5. Install fuel tank to the machine (see Fuel Tank Installation in Chapter 3 – Briggs & Stratton Vanguard Engines).

Front Fork (SP 5020)

Removal (Fig. 20)

NOTE: If disassembly of the front fork and its bearings is required, proceed as follows:



WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 – Safety.

1. Jack up front wheel enough to allow removal of the front fork.
2. Remove fuel tank from the machine (see Fuel Tank Removal in Chapter 3 – Briggs & Stratton Vanguard Engines).
3. Remove cotter pin securing the slotted nut to the fork shaft. Unscrew slotted nut from the shaft. Remove steering washer from the shaft.
4. Pull fork from the frame. Remove upper bearing cone from the frame.
5. Remove lock nut from each adjustment pin. Remove steering chain from the front fork and the sprocket (Fig. 19).
6. Remove front wheel from the front fork (see Front Wheel Removal).



CAUTION

Support front fork to prevent its falling during removal. Personal injury or damage to the fork may result from improper handling.

NOTE: If it is necessary to pry the fork from the frame, make sure even pressure is applied to both sides of the fork to prevent damaging the bearing cone and cup.

7. Inspect bearing cups and cones for damage. Replace bearings if necessary.
8. The chain bracket and chain guide may be removed from the front fork if necessary.

Installation (Fig. 20)

1. Secure chain guide and fork stay plate to the front fork with cap screws, spacers, and hex nuts.
2. Secure chain bracket to the chain guide with cap screws and lock washers.

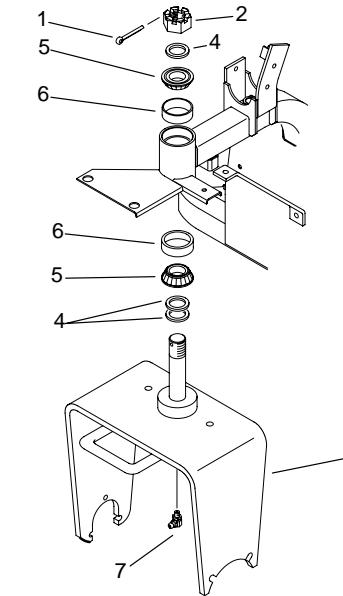


Figure 20

- | | |
|---------------------|-------------------|
| 1. Cotter pin | 5. Bearing cone |
| 2. Slotted nut | 6. Bearing cup |
| 3. Front fork | 7. Grease fitting |
| 4. Steering washers | |

3. If bearing cones or cups were damaged, press new bearing cups into the frame.
4. Install steering washers onto the shaft of the front fork.
5. If bearing cones were damaged or bearing cups were replaced, install new bearing cone onto the shaft with a bearing driver.
6. Position fork shaft up through frame. If bearing cones were damaged or bearing cups were replaced, install new bearing cone onto shaft. Install remaining bearing cone and steering washer onto the shaft.
7. Tighten slotted nut onto shaft until a slight drag is felt when rotating the fork. Back off nut so nearest slot aligns with cross hole in the shaft. Secure nut to shaft with cotter pin.
8. Install front wheel to the front fork (see Front Wheel Installation).
9. Position steering chain around the sprocket and chain guide. Secure chain to chain bracket with steering adjustment pins and lock nuts. Adjust steering chain (see Adjust Steering Chain).
10. Install fuel tank to the machine (see Fuel Tank Installation in Chapter 3 – Briggs & Stratton Vanguard Engines).

Hood and Dash Panel (SP 2020/3020)

Removal

1. Park machine on a level surface, lower attachment, stop engine, engage parking brake, and remove key from the ignition switch.
2. Disconnect black (negative) cable from the battery.
3. Remove three flange head screws securing the hood to the front shield (Fig. 11).
4. Remove four cap screws securing the dash panel to the hood. Remove hood from the machine (Fig. 12).
5. Remove roll pin from upper steering shaft with drift punch. Remove steering wheel from the shaft (Fig. 23).
6. Remove both flange head screws from the dash panel and steering post (Fig. 12).
7. Disconnect electrical connections from the fuse holder, hourmeter, and ignition switch (Fig. 12).
8. Disconnect choke and throttle control cables from the engine (see Throttle Control and Choke Control Removal in Chapter 3 – Briggs & Stratton Vanguard Engines).
9. Pull dash panel up from the steering post and machine (Fig. 12).

Installation

1. Position dash panel over the steering post and to the machine (Fig. 12).
2. Connect choke and throttle control cables to the engine (see Throttle Control and Choke Control Installation in Chapter 3 – Briggs & Stratton Vanguard Engines).
3. Secure dash panel to steering post with both flange head screws (Fig. 12).
4. Connect electrical connections to the fuse holder, hourmeter, and ignition switch (Fig. 12).
5. Position steering wheel to the upper steering shaft. Secure wheel to shaft with roll pin (Fig. 23).
6. Position the hood to the dash panel. Secure hood to panel with four cap screws (Fig. 12).
7. Secure hood to the front shield with three flange head screws (Fig. 11).
8. Connect black (negative) cable to the battery.

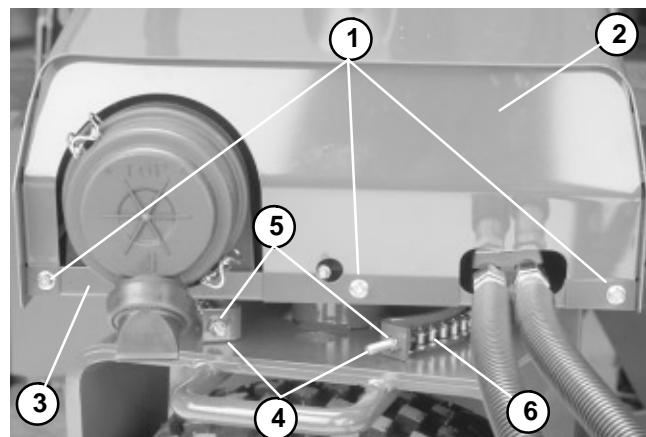


Figure 21

- | | |
|----------------------|-------------------|
| 1. Flange head screw | 4. Adjustment pin |
| 2. Hood | 5. Lock nut |
| 3. Front shield | 6. Steering chain |



Figure 22

- | | |
|----------------------|--------------------|
| 1. Cap screws | 5. Fuse holder |
| 2. Dash panel | 6. Hourmeter |
| 3. Hood | 7. Ignition switch |
| 4. Flange head screw | 8. Steering post |



Figure 23

- | | |
|-------------|-------------------|
| 1. Roll pin | 2. Steering wheel |
|-------------|-------------------|

Fenders (SP 5020)

Left Fender(Seat Base)Removal (Fig. 44)

1. Park machine on a level surface, lower attachment, stop engine, engage parking brake, and remove key from the ignition switch.
2. Pivot seat up. Separate seat rod from the base by removing cotter pin and flat washer.
3. Separate base from frame by removing both lock nuts, cap screws, flat washers, and spacers.

Seat Base Installation (Fig. 44)

1. Position seat base to the frame. Secure base to frame with both spacers, flat washers, and lock nuts.
2. Secure seat rod to the seat base with flat washer and cotter pin. Pivot seat down.

Right Fender Removal (Fig. 25 and 26)

1. Park machine on a level surface, lower attachment, stop engine, engage parking brake, and remove key from the ignition switch. Pivot seat up.
2. Disconnect black (negative) cable from the battery.
3. Remove knobs from throttle and choke controls. Remove cap screws and lock nuts securing controls to the right fender. Pull controls clear of the fender.
4. Remove hex nut and lock washer securing the ignition switch to the right fender. Pull switch clear of the fender.
5. Unscrew knob from the lift lever. Remove both hex flange head screws from the fender. Remove both carriage bolts and lock nuts securing the fender to the rear panel.
6. Loosen hose clamp and remove hose from air cleaner. Remove cap screw, flat washer, lock nut securing the right fender to the frame. Remove fender.

Right Fender Installation (Fig. 25 and 26)

1. Position right fender to the frame. Secure fender to frame with hex flange head screws. Secure fender to rear panel with both carriage bolts and lock nuts.
2. Secure fender to frame with cap screw, flat washer, and lock nut. Secure hose to cleaner with hose clamp.
3. Secure ignition switch to the fender with lock washer and hex nut.
4. Secure choke and throttle controls to the fender with cap screws and lock nuts. Install knobs to both controls.

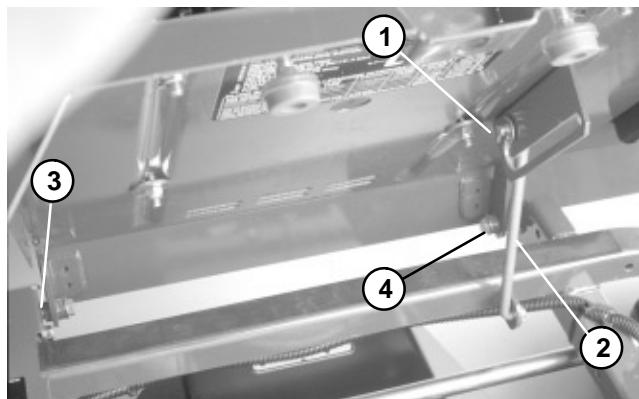


Figure 24

1. Cotter pin & flat washer 3. Lock nut
2. Seat rod 4. Cap screw & flat washer

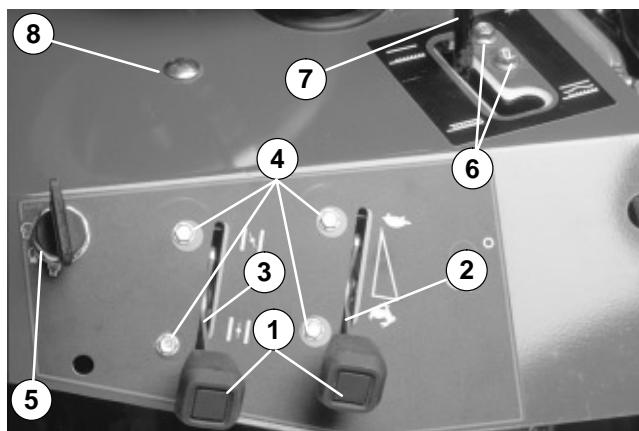


Figure 25

1. Knob 5. Ignition switch
2. Throttle control 6. Hex flange head screw
3. Choke control 7. Lift lever
4. Cap screw & lock nut 8. Carriage bolt & lock nut

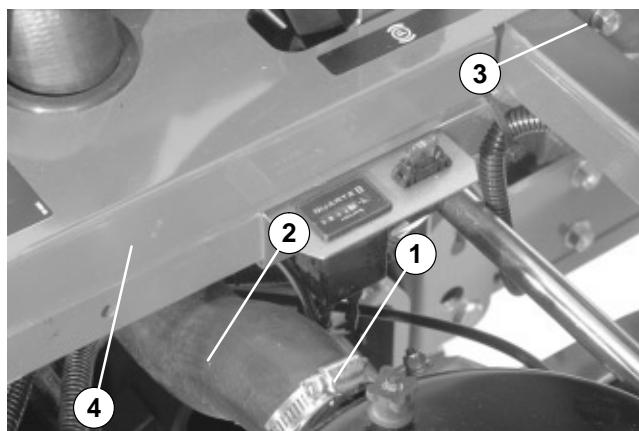


Figure 26

1. Hose clamp 3. Cap screw/flat washer
2. Air cleaner hose 4. Right fender
5. Connect black (negative) cable to the battery.



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